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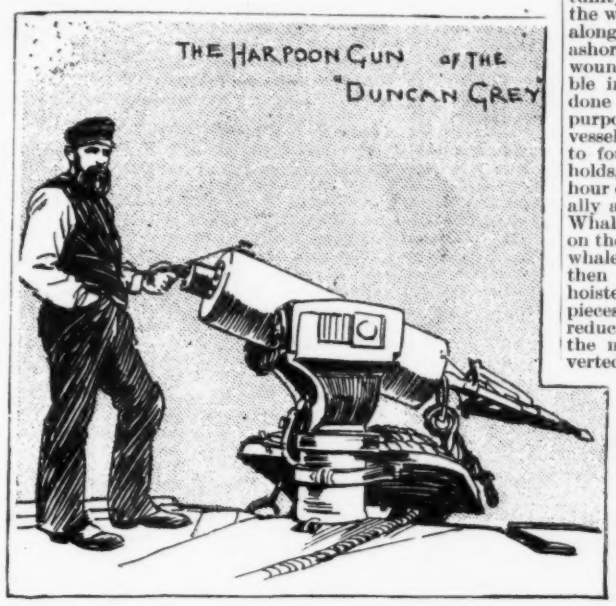
THE EMPEROR WILLIAM'S WHALING CRUISE.

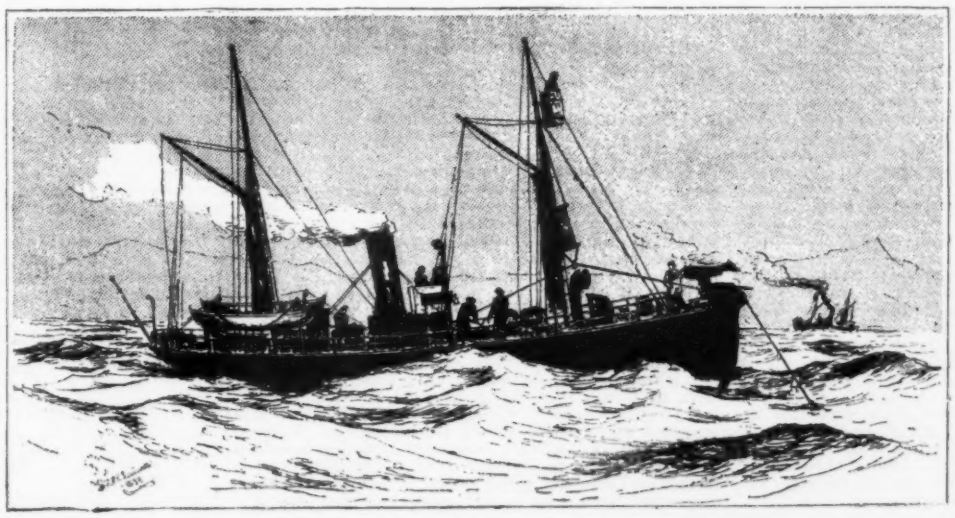
"SKAARO," or "Skoro," where the German Emperor has just been whaling, is a small island in 70°20 north latitude, some fifty miles to the northeast of Tromso. It is the headquarters of the Anglo-Norwegian Whaling Company, whose resident manager, Mr. Gjœver, placed its two whaling steamers, Duncan Grey and Nancy Grey, at the disposal of his Majesty the Emperor William and suite. On the 12th of July last the emperor left Tromso for the island of Karlso, where, on the 13th and 14th, he went reindeer stalking, and shot four deer. On Thursday, about midnight, the royal yacht anchored at Skaaro, and on Friday forenoon, July 15, the kaiser embarked on the Duncan Grey with five of his retinue, the remainder of the imperial suite proceeding with the Nancy Grey, and started on the expedition. At 6:30 P. M. chase was made after a whale, and at 7 o'clock the first shot was successfully fired, the whale itself being killed and secured alongside half an hour afterward, whereupon the vessel steamed back, and arrived at the factory shortly after midnight. The whale itself was a moderate sized specimen 52 ft. in length. A couple of hours later the Nancy Grey, with the rest of the suite, returned with another whale 10 ft. longer than the emperor's. The weather was perfect, and the kaiser and his followers were delighted with the excursion. The emperor wrote an account of the chase, and had it inclosed in a bottle and cast into the sea. Saturday forenoon was devoted to viewing the prizes, which lay hauled up on the beach, and an inspection of the factory, after which refreshments were served on the hill above the establishment, the emperor's health being proposed by the manager, Mr. Gjœver. In reply, the kaiser expressed the very great pleasure he had derived from the expedition, and presented the gunner with a gold medal, the crews of the vessels with money, and valuable gifts to the manager and his family. At 2 o'clock P. M. his majesty and suite embarked, and returned to Tromso arriving there on July 17. Four varieties of whale are to be met with off the Norwegian coast. The largest of these is the so-called "blaahval" or blue whale, averaging about 80 ft. in length and as many tons in weight. Next to it comes the "fin" or finner whale, averaging 70 ft. in length and about as many tons; after which come two of about 35 ft., called "knolhval" or humpback whale, and "seihval" or pollack whale. These whales are more or less alike to an unpracticed eye, except that the finner has a longer and sharper dorsal fin than the blue whale, and the humpback a more lumpy body. The baleen obtained from these ocean mammals varies in color as well as in value. The blue whale yields blue or so-called "black" whalebone, which fetches $1,250 a ton. The seihval also yields "black" baleen, valued at $900 a ton; while the finner supplies gray or so-called "white" whalebone, worth $600 per ton. The "north capers" (*Balœna glacialis*) are never caught in Norwegian waters, but are taken off the coast of Iceland, the baleen derived from them being of the enormous value of about $11,000 a ton. Besides whalebone the Norwegian whales supply a vast quantity of blubber, which, on being reduced to oil, is of great value. The blue whale yields on an average fifty barrels of oil, the finner twenty-five barrels, and the two others about fifteen each. The barrels are ordinary petroleum casks, estimated to contain about 375 lb. weight of oil. In 1891, 704 whales of all sizes were taken off the Finmark coast, yielding over 15,000 barrels of oil, valued at $95 a ton, while the guano from the refuse brought in $27.50 a ton. In 1890 a lesser number of whales was captured (633), but the yield of oil was greater, amounting to 18,000 barrels. There were twenty-seven steamers employed in the Finmark whaling last year, manned by 474 men, but the factories give employment to a great number of hands besides.

The whaling steamers are small boats, averaging about thirty tons, furnished with engines of from 120 to 150 indicated horse power, and fitted with a swivel gun in the bow. Each vessel carries a 5½ inch hawser, 360 fathoms in length, attached to a harpoon projectile, and two reserve cables of equal dimensions, all made of the choicest hemp. The steamers are also fitted with steam winches, and every kind of necessary gear of the best and strongest description. The gun itself is a massive contrivance fixed in the bows on a swivel mounting. By means of a handle at the breech the gunner is enabled to elevate or depress it, and aim with the greatest ease. The recoil is received by several plates of gutta percha placed immediately behind the trunnions, and is rendered imperceptible to the shooter. The gunner stands on a platform, which, by means of wings, overlaps the small angle of the bows and enables him to move about freely. The projectile is a harpoon, armed with movable flukes, and containing in its head a shell charged with explosive matter. The flukes lie flat until on entering the whale backward pressure arises, when they open out and form a grapnel in its body. This movement likewise fires the explosive by which the animal, if struck near a vital part, is generally killed immediately.



On putting to sea a good lookout is kept, one man being stationed in the "crow's nest" attached to the upper part of the foremast. It occasionally happens, however, that the whale or whales will be scented before being seen, owing to the effluvia given off by their lungs when "spouting" being carried great distances.

On sighting its prey, the vessel makes for it, and follows it, may be for hours, before obtaining a chance of a shot. If the harpoon and its shell reach a vital part, little more has to be done than to secure the whale and tow it to the factory. This, however, may be a work of great anxiety and difficulty, especially with large whales. On an average one "blue" out of three sinks; one finner out of ten floats. When it sinks, the steamer is practically anchored to the body, often at an immense depth, and the strain on the hawser is very great. In a seaway the pitching of the vessel would very soon cause it to snap at the bows, and a spring has, therefore, been devised by which the rope is relieved of all sudden tension. This consists of a contrivance called an "accumulator," formed of twenty-two stout gutta percha rings encircling an upper and lower slab of tough ash, each 2½ ft. in length, 3 in. in width, and 3 in. in thickness, the upper one being fastened by a triangle of rope to the mast just above the "hounds," a triangle in its turn from the lower one supporting a block through which the harpoon hawser is passed from its sheave at the bows to a block and steam windlass on deck. When opportunity occurs, the hawser is gradually hauled in until the whale is finally raised to the surface and secured alongside or astern, when the process of towing it ashore commences. If, however, a whale is only wounded, it will do all it can to rid itself of the terrible instrument that holds it. Nothing can then be done but to let the beast exhaust itself, for which purpose the engines are stopped, while it tows the vessel where it listeth, often at a rate of from twelve to fourteen knots an hour. Provided the hawser holds, the vessel may thus be drawn about for from an hour or two to a day or a couple of days, and occasionally after a long run the whale may finally escape. Whaling stations are established at convenient spots on the coast, each having its factory and stores. The whales are towed to the place by the steamers, and then hauled ashore, where the blubber is removed, hoisted into the factory, where it is chopped into fine pieces, and then forwarded to the boiling shed to be reduced to oil. All but the baleen, which is cut from the mouth, and blubber, is refuse, and this is converted into guano, which sells at a fair price.—*Daily Graphic, London.*



STEAMER DUNCAN GREY, WITH THE GERMAN EMPEROR ON BOARD, FAST TO A WHALE

THE MODERN MARINE BOILER.

By A. B. WILLITS, U. S. N.

THE marine engines, often things of beauty, and always interesting in their steady, graceful and potent functions, receive all the praise when the ship is making or breaking a record. While it is not at all uncommon to find the ordinary commercial traveler versed in the technicalities of this portion of the machinery, and able to discourse glibly on the relative "horse power" of the leading transatlantic liners, it is seldom that he has much knowledge of the boilers, those vast factories and reservoirs of that power of which he speaks, and which, in their hot and grimy compartments forward, giving but few signs of the intense strain they are under during every moment of the run, perform a duty not in the remotest degree indicated by a share of the glory of a successful trip. It is probable, nevertheless, that in the mechanical world to-day, more thought is being bestowed on the boilers than on the engines proper; and far from being commonplace accessories, they are constructions of the most scientific character, combining in their proportions the results of the greatest range of experiment and deepest study. Each element is so carefully considered, both by itself and in its relation to the other parts, that the final outcome is an apparatus of elegance to the professional eye, and one in which strength, durability, accessibility and efficient capacity are adjusted to a nicety which satisfies the conditions imposed with regard to the production of a given power within a limited space and with a minimum weight of metal.

The boilers of the United States man-of-war New York, now in the course of completion in Philadelphia, are of greater dimensions than any previously built in this country. They do not differ in size, in any marked degree, from the largest built abroad for the ocean greyhounds, although the latter possess more heating surface in proportion to grate, to their economical advantage at full power. Each is 15 ft. 9 in. in diameter and 18 ft. long, and is double-ended, having an exactly similar arrangement of furnaces and tubes in each end. The tubes conduct the hot gases and smoke of combustion from the backs of the furnaces to the fronts of the boiler, whence they are led to the smoke-pipe by light castings, attached after being placed on board ship, this type being styled the return fire tubular or, more generally, the Scotch boiler. The material is open-hearth steel, subject to the closest inspection and severest tests before acceptance. The nine great sheets composing the cylinder are more than one and a quarter inch thick (1¼) and weigh between five and six thousand pounds each. The flat-

heads are thinner, but so closely stayed by heavy steel braces running from end to end as to compensate for that. Indeed, if wholly unstayed they would have to be of simply monstrous proportions to sustain the pressure put upon them, something like ten inches in this case, which would be both impractical and absurd. Spherical ends would of course obviate bracing and ultra thickness, but the practical advantages of flat ends are retained by a scientific system of bracing. Each boiler weighs about seventy tons and contains eight furnaces, and 1,148 tubes, aggregating nearly a mile and a half in length. These form the major part of the 5,200 square feet of heating surface, as they are always surrounded by water to be evaporated. The quantity of water necessary to fill the boiler to a proper steaming height is about thirty tons, yet under forced combustion, such as is always used for full power, this is converted into steam at the rate of ½ of a ton per minute, demanding a continuous supply from the pumps, at that rate, to maintain a safe level. The furnaces contain 165 square feet of grate, upon which is burned nearly three tons of coal per hour (about 40 lb. per square foot per hour), with an air pressure of less than one-tenth of a pound per square inch above the atmosphere. The steam pressure carried is 160 lb. per square inch above the atmosphere, quite the usual pressure for triple expansion engines, but when it is realized that this gives a total disruptive strain on the cylindrical shell of more than 6,500,000 pounds, it no longer appears as ordinary, but rather terrific; a force, too, which is not evidenced by the placid exterior of this veritable torpedo.

Taking the entire six main boilers of this ship, a brief summary of data is at least impressive and suggestive of the importance of these elements. Their net weight is more than 400 tons, and they contain about three-quarters of an acre of heating surface, with eight and a half miles of tubes. Their forty-eight furnaces will consume more than 400 tons of coal a day and evaporate 140 tons of water an hour to produce the 16,500 horse power needed to drive the vessel twenty knots an hour. They occupy a floor space in the depths of the ship 100 feet long by 36 feet wide (double that allotted to the main engines), and will require a force of a hundred men to properly attend to and manipulate them. A contemplation of these few facts makes it obvious to ony one that a high degree of skill and efficiency on the part of the attendants is important and necessary, and that the element of carelessness here would be as likely to cause havoc and disaster as it would in the engine room or on the bridge. Eternal vigilance is the watchword, responsibility and anxiety being ever present with the performance of this unseen duty. It has been mentioned before that the boilers of the great ocean liners were proportioned with a larger ratio of heating surface to grate area than those of men-of-war, and it is to this fact that the former show a more economical performance by obtaining a given power on a lower coal consumption. Badly informed writers have used this to animadvert upon the designers or constructors of warship machinery without troubling themselves to find a reason for the difference in results, yet it requires only ordinary reflection to perceive that the conditions in the two cases are wholly dissimilar.

The engines of mail steamers are driven to their full power at all times, and the question of coal expenditure becomes of financial importance; hence their boilers are always designed especially for economy, and the necessary space in the ship is unhesitatingly taken. To follow this line in a naval vessel, of much less length for equal power, would incur a very excessive sacrifice of hull room over that now given.

The adoption of forced draught has made it possible to obtain enormously greater evaporation from a boiler of ordinary design than was possible with natural draught, by reason of burning a much greater quantity of coal on the same grate. To do this economically, however, the heating surface, or surface of absorption of the heat from the gases of combustion, must be greatly increased, which means larger or more numerous boilers. The designers of machinery for warships have carefully considered the bearing and contingencies of this feature, and have adopted as efficiently proportioned boilers as the existing conditions justify. The assumption is that the full power of this class of vessel will never be required except for short periods, when the production of it at the lowest rate of economy will not be vital; and a mean is considered advisable, where space is of such paramount importance. The quality of workmanship shown in the details of construction, with its guarantee of durability, is second to none in the world.

The desire of marine engineers is to produce a type of boiler which shall do away with the necessity of such enormously large and heavy shells, and present a lighter substitute which will perform the duties of both envelope and heating surface conjointly. A very great reduction in size and weight is thus possible, and the numerous forms of tubulous boilers are the outcome of this desire, which, year by year, is intensified by the gradual necessary increase in the proportions of the cylindrical type. The tubulous boiler consists of numerous tubes of comparatively small diameter, and variously connected, inside of which the water circulates, and around which a light casing of metal, lined with refractory material, is built to confine the hot gases to action upon their outer surfaces. Thus the tubes become parts of the shell as well as continuing to be heating surface, and by reason of small diameters, even in the connecting drums, all very thick plates are avoided and the highest desirable steam pressure safely carried. The amount of contained water is also greatly reduced as well as much more effectively disposed for evaporation than obtains in the Scotch boiler, where the water is solid bulk, much of it below all heating surface, and only brought to the boiling point slowly or by forced circulation. For years this tubulous form has found favor for use in smaller vessels, such as torpedo boats or launches, but its adoption for larger ships has been delayed for reasons which, temporarily at least, counterbalance the evident advantages of less weight and size, better circulation, more efficient evaporation, and the rapidity with which steam can be raised. One of these is that their very compactness militates against their accessibility for cleaning and examination, and it is feared that without a possibility of unusual care their decay will be rapid and their life short, when placed in the damper holds of deeper vessels, where their use will be interrupted by long periods of idleness. Besides this, the ready renewal of defective tubes is not perfectly provided for in most designs, and many practical difficulties have attended this work with the smaller sizes, despite a theoretical demonstration of the ease of such operations. Especially is this true after some considerable use, and indicates a probable trouble and incites caution in those who would like to abandon the bulkier but more accessible form.

Experiment, of course, is the only way to prove their real adaptability to the service required, and the government has placed on board the United States cruiser Monterey, just built in California, four tubulous boilers. Much interest centers in the coming trial of these boilers, but upon the reports which shall be made by the engineers in charge, after a continuous experience with them under the various conditions of a cruise, will depend any verdict of value. The field is still open for inventive minds, as the perfect type has not yet been evolved. The study is in better shape now by reason of the many devices already constructed and found wanting, as their faults, as well as their points of excellence, serve to aid the designer in marking his lines for improvement.—*Engineering Magazine, N. Y.*

THE MANIPULATION OF METAL IN THE MANUFACTURE OF AMMUNITION FOR MODERN BREECH-LOADING RIFLES.

IN the early days of the breech-loading rifle the manufacture of proper ammunition was a slow, expensive process. The various parts of the shell were soldered together; the body of the shell was made of sheet metal rolled into cylindrical form and soldered, the head was turned in a lathe to fit the body, and, having a proper rim, the two parts were then soldered together.

The supply of ammunition was far inferior to the demand, caused by the improvement in firearms, and a new industry sprang up, giving employment to many skilled and unskilled workmen, and causing the invention of many new forms of machinery to accomplish some seemingly difficult operations.

The manipulation of the metal in the present process of manufacturing ammunition, or cartridges, is very interesting in all its parts. First, there are two classes of cartridges made, viz., the rim and the central fire, the methods used in the manufacture of each being essentially the same, the central fire requiring one or two more operations.

A cartridge consists of, first, a shell, which must be of a certain size in order to fit the chamber of the rifle; it must be of a certain length, that its capacity will be such as will contain a specified amount of powder; it must have a head or rim so as to be easily extracted from the chamber after being used; it must have a receptacle in the head for receiving the primer and a small hole in the bottom of the receptacle which allows the powder to come in contact with the explosive of the primer; second, it must be provided in the open end of the shell with a missile, commonly called the bullet or ball, or, in speaking of large mounted guns, the projectile, which is of certain size and weight.

The shell being the most important part of the cartridge, is at present, by the result of study and ingenuity, made from and consists of one continuous piece of metal.

The metals used are copper and the alloy brass. These metals are used owing to their superior malleability and great tenacity. Sheets of these metals are obtained of a proper thickness, depending upon the size and caliber of the shell; the desired or necessary amount of metal is determined by the weight of a model shell; circular disks are punched out of the sheets, which contain a trifle more than the necessary amount of metal; the disks are forced through a die by a punch and a strong press, bending the disks into the form of a cup, as in Fig. 1. These cups are then

Fig. 1.

forced through other dies, which decrease their diameter and thickness of the sides, the thickness of the bottom remaining the same. The diameter is reduced slowly, only one one-thousandth of an inch per operation, and the cups are forced through many dies before they have obtained the proper length, diameter and thickness.

The effect of the drawing process is to harden the metal, making it stiff and springy, tending to impair its malleability, making necessary a process of annealing. This is quite simple. Large cylinders are made of light boiler iron and of iron grating with small meshes. The cylinders have proper opening and cover, a spindle which revolves in half bearings and is easily removed, and a pulley at the end of the spindle. A large number of the cups are placed in the cylinder and slowly rotated over a furnace, by means of a belt; the cups are evenly heated to a red, the motion is then stopped, the cylinder quickly removed from its bearings and the contents dumped into a vat or tank containing a solution of water and sulphuric acid, H_2SO_4. This sudden immersion of the cups anneals the metal, viz., restores its malleability, and the presence of the acid removes a scale caused by oxidation. The solution is not strong, containing only from 10 to 15 per cent. of commercial sulphuric acid, or what is commonly known as oil of vitriol. The annealing process is repeated many times during the process of drawing the cups. It is absolutely necessary for the production of uniform work, for preserving the malleability of the metals and saving a great waste which would otherwise occur from the cups being cracked and rendered useless. The acid solution is then drawn off and the cups thoroughly washed, quickly dried, and the drawing process continued until the proper length and diameter are produced.

The dies used are simple in construction, made of very fine steel, such as Hobson's choice or Jessop's refined. They are dulled, reamed, the upper edge of the hole being nicely rounded, the outside being turned to fit a holder, the hole is left slightly smaller than the required size, the die is hardened and then ground to the proper size by means of a brass mandrel and very fine emery. The dies after being used often become worn. They are then rehardened, the shrinkage bringing them back to the proper size. This is a so-called "trick of the trade," and is sometimes repeated three or four times. It should not be repeated more than twice, as the strength of the steel is impaired and serious damage is often done by the breaking of a die, it being much safer to replace a worn die.

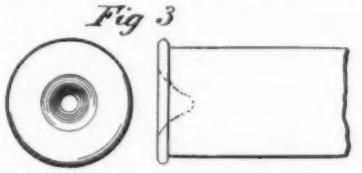
The punch is a simple steel rod, the end being nicely rounded, turned to fit the internal diameter of the cup and properly hardened. The press is of simple and strong construction, the die and its holder being firmly bolted to the bed, the punch being operated by a powerful eccentric; each machine has an iron disk with a certain number of holes evenly divided. The disk moves over the die, and each hole being in line with the hole of the die, the disk has a ratchet with a number of teeth corresponding in number to the holes. The ratchet is operated by the return or upward stroke of the eccentric, and the workman need only put the cups in the holes as they pass by, a cup being brought to the proper position over the die at each return stroke of the punch.

The shell or cup having been drawn to its proper length, diameter, and thickness, has the appearance as Fig. 2, and is now ready for the heading operation. A

Fig. 2.

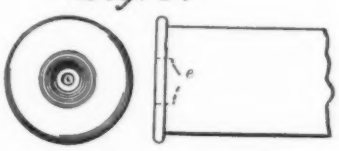
proper sized mandrel, with a slightly rounding impression in the end, is inserted into the shell, then firmly clamped into the jaws of the heading machine. The jaws, two in number, each contain one-half of the heading die. The bunter is merely a punch which forces the metal into the die and into the impression of the mandrel giving the head, as in Fig. 3, also rim and

Fig 3



impression represented by dotted line. The shell is then put through another punch operation, the die fitting the inside and the end having the proper impression, the punch forcing the metal into the die, and making a neat receptacle for the primer, as in Fig. 4. A hole is then punched into the small impression

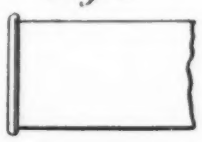
Fig. 4.



at *e*, which allows the powder to come in contact with the explosive in the primer, and the trade mark and caliber for which the shell is to be used stamped upon the head. At the same time the shells are then neatly trimmed at the open end to the required length.

Rim fire shells are made by the same process, except that they are merely headed as in Fig. 5 and then

Fig. 5



trimmed. Fulminate of mercury is dissolved in a proper liquid and a few drops put into the rim fire shell. The liquid by the principle of capillary attraction adheres to the little space produced in the head by the doubling of the metal. The solvent evaporates, leaving the dry fulminate in the rim; the hammer or fire pin must strike the rim to explode the fulminate. From this peculiarity this shell derives its name, viz., rim fire cartridge.

The primers used in the central fire are made in the same way as the cups. Small disks are punched out of thin metal and forced through a die which bends them into the form of Fig. 6. A little fulminate is put in—a

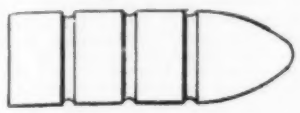
Fig. 6.

few grains—and covered with a disk of tin foil; the primer is provided with a miniature anvil which insures their explosion, but lately it has been disposed of and

is unnecessary. The primers are gently pressed into the shell and the shell is ready for loading.

The bullet is of certain length and diameter and is made in perfect steel moulds of an alloy of lead and antimony, in the proper proportion to give the proper hardness. The ball also contains grooves which reduce the friction in the barrel and are filled with grease to lubricate the barrel, as in Fig. 8. The required amount

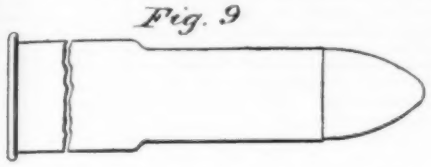
Fig. 8.



of powder is put into the shell and then wadded by a disk of pasteboard of proper diameter and the bullet pressed into the open end over the wad, thus completing the cartridges, which are neatly packed for the market.

Bottle-neck shells are made by a simple process of drawing; they appear as in Fig. 9, and the object is to

Fig. 9



increase the amount of powder without increasing the size of the ball, it being only necessary to increase the size of the chamber in the barrel.

Tapering shells are also made by forcing them in and out of a series of tapering dies. The only object is to facilitate or help in extraction, but the advantage gained is slight in comparison to the expense of the extra operations to make tapered shells. Slight taper and straight shells are mostly used.

The principal standard calibers are 22, 28, 32, 38, 40, 41, 45, and 50; the 28 is obsolete, as it was only used in a pistol made by E. Remington & Sons; the 45 is the regulation of the United States regular army; the 50 is that used by privates of the N. G. S. N. Y.

A large number of these can be carried with convenience. The principal factories in the United States are the Winchester Repeating Arms Company and the Union Metallic Cartridge Company, of Bridgeport, Conn. The firms have facilities for turning out or producing many thousand cartridges daily.

The soldier or marksman has simply to insert the cartridge, lock the breech block, pull the trigger; the concussion of the hammer, aided by the fire pin, explodes the fulminate in the rim or primer as the case may be, which ignites the powder of the shell, generating a large quantity of gas in an infinitesimal space of time, driving the ball through the rifled barrel, giving it accuracy, impulse, high velocity, force, penetration and destructive effects. S. W. ARMINE.

Whitestone, L. I.

PORT'S UNIVERSAL WRENCH.

THE universal wrench, a recent French invention, is a tool of singular originality that has required on the part of its author very laborious work in combinations presenting numerous practical difficulties.

The problem, in fact, consisted in grouping a large number of ordinary multiple tools, of varied forms, in a single piece, and in such a way that such grouping could be effected without necessitating an apprenticeship on the part of the person using it. Such is the work of patience realized in the combination under consideration.

As the accompanying figures show, the universal wrench comprises a series of tools in everyday use in almost all trades—the monkey wrench, the ax, the adz, the hand saw, the screw driver, the vise, etc.

Fig. 1 represents the wrench complete and capable of being used for turning nuts of all sizes and of serving as a hammer. The apparatus thus condensed may be taken apart in eleven pieces. The two jaws, one of which is fixed and the other movable, are of tempered steel. The handle is of varnished wood traversed by a square steel rod. The body of the wrench is of bronze.

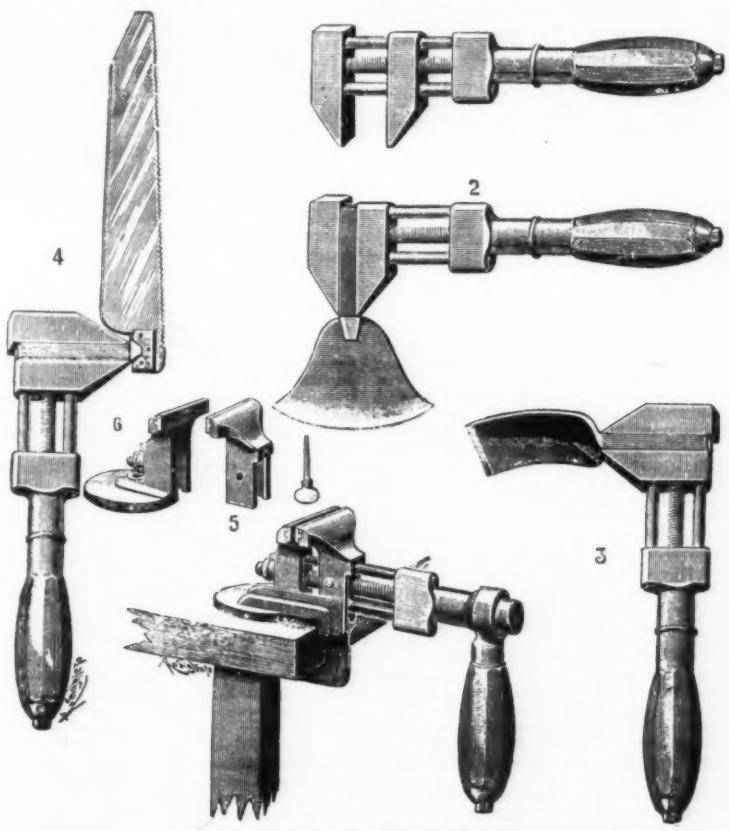
In order to convert the wrench into an ax, adz, saw, etc., it suffices to place the tool that it is desired to use between the jaws, and then screw up the wrench. The number of tools capable of being adapted to the wrench is somewhat indefinite. A pick or shovel even can be fixed to it.

The conversion of the wrench into a very strong vise capable of regular and practical operation is one of the most ingenious combinations of Mr. Port's invention. Such conversion is effected by means of two movable bronze bits with steel clamps that engage in the jaws of the wrench. The figures show the vise fixed to a table, as well as the different pieces of which it is composed.

As the pressure that may be exerted between the jaws by means of a small key is very strong, the wrench may be used for chasing, embossing, and threading and cutting tubes, etc., by means of small matrices that are very easily adapted to the tool.

All the parts are interchangeable, and can be readily replaced, if any one of them becomes worn.

Upon the whole, this very simple little apparatus realizes for mechanics a progress that merits notice. Several tentatives in this direction had already been made, but without success, their authors having abandoned the idea in face of the difficulties to be surmounted.—*Le Genie Civil.*



PORT'S UNIVERSAL WRENCH.

BLOCK SIGNALS.*

A GREAT deal has been written on this subject during the past year; railroad officers have given more attention to it than ever before, and the American Railway Association (formerly called the General Time Convention) has appointed a committee to consider and recommend a standard block signal system, involving as it does the very safeguard to the reputation of any railroad that attempts to meet the demands of the traveling public for high speed and safe transportation.

The English or Sykes system is the one now generally in use. Does it meet the requirements and give the necessary security? To answer this question let us first give, briefly, the method of protecting trains by this system, with which, however, a great many of you are familiar.

Each office is supplied with a semaphore signal; the lever controlling the arm is locked—an operator desiring to give a signal to an approaching train must ask the operator in advance to unlock his lever; the signals between block stations are given by bell code on some roads, and on others, where the locking arrangement is not used, by the regular Morse code. As soon as the train passes into the next block, the operator places his signal to indicate danger, the lever being again locked. He then signals the operator in the rear that the train has passed out of the block. On crowded roadways, and especially where trains are "closing up" on approaching the great terminal points, these signals must be given instantly, so as not to detain the following train. Herein lies a very great danger. This was brought more forcibly to my mind by reading the very able article written by Mr. Theo. N. Ely, general superintendent of motive power of the Pennsylvania Railroad, and published by *Scribner's Magazine* for March, on the subject of train speed.

Mr. Ely claims that "speed at the rate of one hundred miles an hour is no longer a question of motive power, but one of transportation facilities and methods;" and, after calling for a perfect roadbed, "the alignment almost free from curvature, etc.," he says, "one hundred miles per hour is made possible, but only upon the fulfillment of one other condition, namely, a clear track ahead."

All talk on the question of such a high rate of speed may appear to be based on theory, but if you will consider for a moment that our "limited" trains of to-day are scheduled at an average of about fifty-three miles per hour (this, of course, includes all stops, adding the time thus lost to that which is lost in climbing heavy grades, running slow through cities, towns, etc.), these trains must maintain an average of more than sixty miles per hour, and this means seventy-five and eighty miles per hour on the best running grounds. And, further, the high speed of our fast freight trains and the distance covered by such trains after the brakes have been applied for an emergency stop will, I think, convince all of you that we are surely and rapidly advancing to the high limit now set, and that our block signals have not kept pace with it.

This brings up the question, how soon, after receiving warning of danger, a train running at this speed can be stopped. Accepting the figures given by Mr. Ely (for I am sure we recognize in him a competent authority), it is estimated that a train running at the rate of sixty miles per hour with full braking weight of the train and rails in the most favorable condition could be brought to a full stop in 900 ft., at eighty miles per hour in 1,600 ft., at ninety miles in 2,025 ft., and, finally, at one hundred miles per hour in 2,500 ft.

You will observe that these figures are based upon the most favorable conditions, but such conditions cannot be relied upon. Starting a train, either passenger or freight, from Buffalo, with every part in perfect order and weather clear, the load may be heavier on one day than on another, making it harder to stop, and before that train reaches New York the brake shoes are worn, the leverage is strained and pulls unevenly, the track is wet and slippery along the Hudson, and the fog obscures the signal until the train is very close to it. Should we not then base our figures on the most unfavorable conditions? and, again quoting Mr. Ely, ask that "the train receives its warning at least three-quarters of a mile before it must halt"?

Now, coming back to the point of danger, the operator has "cleared" his block, but the train has only gone 1,000 ft. into the next block, and, from some cause, has stopped. Before this is discovered the fast train following has been given a clear signal at the station in the rear and covers the 4,000 ft. between the two signal stations in about twenty-seven seconds; there the engineer finds the signal in danger position and applies the brakes, but, according to Mr. Ely's figures, the momentum and weight of that train will carry it at least 1,500 ft. beyond where the preceding train has stopped, and the result is a collision.

An effort has been made to meet these new conditions by placing a signal back into the block (commonly called the overlap) to indicate the position of the home signal; this is also operated by a lever, interlocked and included in the combination governing the system. This will lessen the danger, but with this mechanical arrangement the signal cannot be placed back far enough to entirely eliminate the danger. Another point of danger is that an operator can unlock the signal in the rear if his own lever has been unlocked, and thus permit a second train to come into his block.

The Hall Signal Company now have an improvement on the Sykes system which covers this point, and is arranged so that a train in passing out of the block depresses a track instrument; this is connected electrically with the unlocking device, so that it is necessary for at least a part of the train to pass out before the lever can be unlocked.

There is still another and greater chance for an error in this system, as well as in all other non-automatic systems. We must depend upon the operator to see that all of the trains pass out of the block. As you well know, all trains carry "markers," to denote the last car; the operator is expected to see the markers and to not report the train clear until he does see them. If the train has broken in two parts and the first part goes by the office and the operator fail to notice the absence of the markers, it is quite probable he will report "train clear," and the following train will be admitted to the block under a clear signal to find the detached portion of the preceding train unprotected by a flag, as the trainmen depend upon the block signal, and do not get very far from their caboose. It is claimed for the Sykes system that two persons must make a mistake before a wrong signal can be given. This is true in so far as the unlocking part is concerned; but, as I have shown in the case of a train stopping soon after passing the block, an accident is possible even with all regulations obeyed, but in the last case one man makes the error by failing to see the markers.

The arrangement of the pneumatic system seems to cover these points, but I believe the same protection is afforded by any other system that is operated by a track circuit, and with very much less machinery to get out of order.

If we then conclude that the present systems must be improved to secure absolute safety, what will be the system of the future?

Will it be entirely automatic, by means of the rail circuits?

Will it be electro-pneumatic, with an attachment to the last car, or will it be, as a writer in the *Railway Equipment Guide* for April suggests, "a system that will display signals continuously throughout each block, so that the signal to proceed or stop will always be in view of the engineer." This idea strikes me very favorably. With such a system the operator controls a line of signals for a certain distance in the blocks each side of his station. In any event, it is my opinion that electricity will play an important part in the block signal of the future, and as the superintendent of telegraph, or division operator, is the man to whom elec

* Read at the eleventh annual meeting of the railway telegraph superintendents, Denver, Col., by J. B. Stewart.—*Journal of Railway Appliances.*

trical matters are intrusted, I venture to bring the matter before the members of this association that we keep in advance of the movement, and in the hope that some of you will be fortunate enough to devise the system that will meet all the conditions.

My own experience and observations have led me to believe that a combination automatic and manual will meet the requirements, and I would suggest that the blocks be not less than three-quarters of a mile, the home signal operated by a lever, and signals operated by electricity and gravity or air pressure placed 1,000 or 1,500 ft. apart throughout the block, the circuit connecting these signals to be also connected with the lever at the home station, so that in moving the lever to place the home signal at danger, the circuit will be opened and the signals go to gravity, or weight; these signals will give ample notice of the position of the home signal and protect a train stopping just beyond a block station; it also admits of giving notice to the train should the block ahead clear after the train passes the distant signal, and schedule speed may be resumed before the train reaches the home station.

To eliminate the chance of an operator unlocking the lever while any part of the train is in the block, I would add to the above the connecting and insulating of one line of rails throughout each block, this rail to be free from contact with cinder ballast (stone ballast gives best results), running taps from this rail circuit to one side of the metallic line circuit, which is used to unlock the lever at the office in the rear.

A train passing over the block will ground the side of the circuit connected by taps to rail, close the relay, and the local of this relay will lock the lever which operates the home signal, open the circuit of block in rear, and will remain so until the last pair of wheels connected by a metal axle passes out of the block. With this arrangement it will not be essential that the operator see the "markers."

There will, of course, be objections raised by railroad officers to depending upon electricity, and their past experience may justify them in doing so, but I believe that it can be depended upon, and in my opinion the day is not far distant when it will be.

All failures can, undoubtedly, be traced to defective designs or instruments, failure through inattention to the batteries, or perhaps all together. We have track circuits, both opened and closed; also electric signal circuits, normally closed, and I require that a closed circuit battery be renewed every fourteenth day, no matter what its conditions may be, new zincs placed in the track battery, and using the cleansed zincs in the local circuit.

With this systematic way of handling the batteries, and reliable men to do the work and to watch the circuits, there will be no failure of the electrical parts. We have been experimenting with the Beatty zinc on our track circuits with very good results. The zinc is self-cleaning, and always presents a clean surface, and, if the solution is kept at a proper strength, a uniform current is given out, so that changing the adjustment of relays is unnecessary. We are also trying them on normally open circuits, and expect to use them to replace Leclanche cells with gravity, as they do not run out if short-circuited.

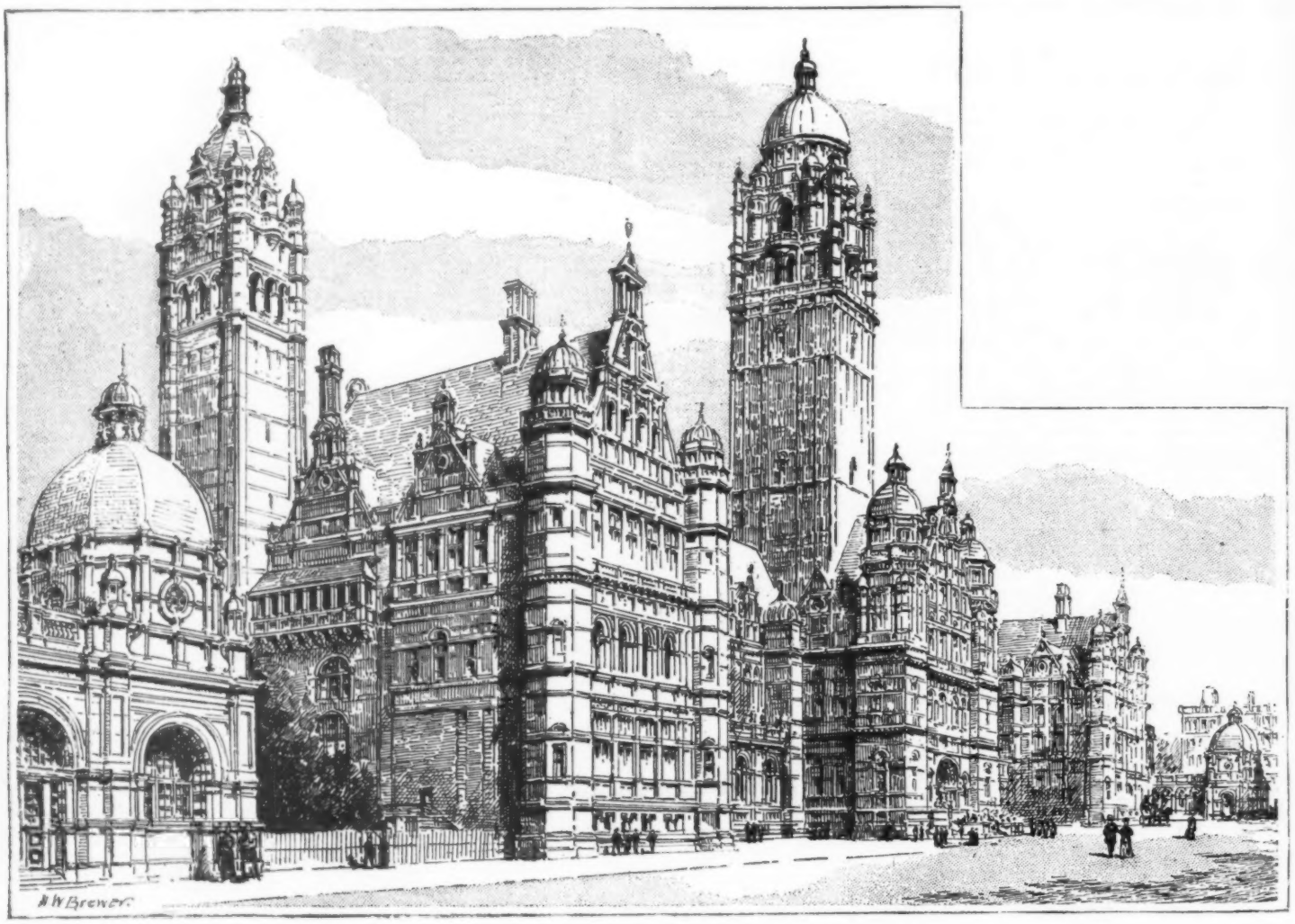
The first cost of the Beatty zinc is a little more, but a less number of cells is required, and the zinc does its work until nothing is left but the stem.

Since we arrived here our attention has been called to a new battery, which, if further tests prove as satisfactory as those already made, the zinc will no longer be needed, and a long step taken toward the ideal gravity battery.

With a good and reliable battery, I believe that electric signals and highway crossing bells will come more generally into use, and, by requiring strict attention from men in charge, our officers will soon lose their distrust of electrical appliances and recognize in them very useful and economical adjuncts to the service.

THE IMPERIAL INSTITUTE, LONDON.

AMONG all the stately and happy ceremonials of the Queen's Jubilee, none possessed greater intrinsic significance than the laying of the foundation stone of the Imperial Institute by Her Majesty. That event, as it marked the completion of the preliminary stage in the realization of the idea of showing by a permanent memorial the expansion of the empire during the fifty years of Queen Victoria's reign, was of national importance. The noble design of the founders of the institute has not yet been completed, but today a magnificent palace, ample in its proportions as befitting the world-wide empire which it symbolizes, and well adapted for the several purposes for which it is intended, occupies the site at South Kensington made familiar by the series of exhibitions of which the Colonial and Indian Exhibition of 1886 was the last.



THE IMPERIAL INSTITUTE, LONDON.

By accepting the advantageous offer of the Royal Commissioners of the first International Exhibition, the owners of the site, the executive of the Imperial Institute have been enabled to devote to the building the greater part of the public funds raised, and a total area of nine acres is now covered with the structure and its courts. Looking down from the parapet of the great square central tower—the cupola of which remains to be built—one notes immediately on the north side the full proportions of the Albert Hall dome, with the cross of the Prince Consort Memorial rising behind it. The Royal College of Music, also in process of building, occupies the ground between the north gallery of the Institute and the Albert Hall, with the City and Guilds of London Technical Institute adjacent. In front, to the south, the immediate object seen is the Natural History Museum, the ground intervening on the other side of the new wide avenue lying ready for new buildings of the South Kensington Museum, or other public institution, which should harmonize with the surroundings. The trees of Hyde Park and Kensington Gardens, the open spaces, and the glint of the Serpentine form an agreeable contrast to the regular lines of streets and blocks of tall houses—dwarfed from this height, however—which characterize this part of London.

Though the building is to a certain extent shut in by its surroundings, and it is difficult to get an adequate idea of its actual dimensions, yet no eye can fail to be captivated by the magnificent facade along the north side of the Imperial Institute road. The actual length of the main building is a little over 300 yards, but it is intended to connect it on either side with the arcades left from the previous exhibition, thus making the whole frontage one long line of 300 yards. Mr. T. E. Colcutt, the architect, has adopted the Renaissance characteristics, and the general impression conveyed by the *ensemble* of the building is one of strength and permanence, relieved by ample mouldings in the gables and carvings of the balustrades. Portland stone is the material chiefly employed in the structure, and as this comes from the Whitbed Quarry, it is hoped to long withstand deterioration in the London atmosphere. The great portal, flanked by lions and other statuary from Mr. Pegram's chisel, is being ornamented with a frieze covered with symbolic sculptures, and with a seated figure of the Queen. At the side is the great foundation stone, brought from the Cape, of three tons weight. Passing through the main entrance a vestibule is reached, into which a polished stone corridor opens, running on either side to the end of the building. The vestibule will give access behind to the great reception hall, the building of which has been postponed, as it is intended to be the finest part of the interior. Opening out of the corridor on the principal floor are spacious conference rooms for the American, Australasian, African, and Indian sections, the administrative offices, and temporary library and reading room. The chief conference room and the library building at the west and east ends respectively are among the portions of the building of which the funds do not yet admit of erection. Ascending from the main entrance by a highly decorated marble staircase, we reach the first floor, which is devoted to conference rooms of the crown colonies, meeting rooms for societies connected with the institute, and the departments of commercial intelligence. The corresponding rooms on the floor above are chiefly intended for the sample examination stores and laboratories, a map department, and for the social use of the fellows of the institute. Parallel with the main building, in its rear, and separated by quadrangles, run two long galleries, the intermediate and the north, in which will be stored, in individual sections, the exhibits of the various colonies. In many cases a nucleus has been acquired in stores handed over by the Colonial Commissioners from the Colonial Exhibition of 1886, the Indian section especially starting, through this means, with a considerable display.

THE OBJECTS OF THE INSTITUTE.

Manifold as are the branches of the work for which the institute is intended, full scope will be found for them within the walls of the palace, which, but for the bereavement in the royal family, would have doubtless been opened in the course of the present year, with as much splendor as marked its foundation. It has been judged expedient, however, as the preparations are sufficiently advanced, to make the building available at once for its intended use. In his letter to the Lord Mayor of London in 1886, the Prince of Wales sketched in outline the objects of this Jubilee memorial, the form of which is due to his own suggestion, and which has taken definite shape under his constant

active supervision. It was to be "at once a museum, an exhibition, and the proper locality for the discussion of Colonial and Indian subjects."

The grants already guaranteed by several of the great colonies insure their active interest in the maintenance of their own sections. In their own stately chambers in the front of the building, decorated with woodwork sent from the colonies themselves, the special conferences of the British American representatives, and of the British Australasian in the west wing, and those of the British African and the British Indian in the east wing, may be expected to decide issues of great commercial importance. The colonial importer and the manufacturer of the great industrial centers will find a common meeting place for the discussion of kindred interests, while opportunities will be afforded for the inspection in the galleries of samples of the products of every part of the empire. As an intelligence department serves to keep the War Office acquainted with the military resources and requirements of every land under the protection of the British flag, so a commercial intelligence department will have its headquarters in the institute, where systematic information upon the commercial development and the products of the various colonies may be obtained for the furtherance of British trade. The details of this system are being worked out with great elaboration. The arrangement of the Indian section is most advanced, and in the index museum it is already possible to compare various specimens of cotton fibers, rice, gum, and other raw products. Thus valuable help in no long time will be forthcoming from the institute in the improvement of commercial education by scientific organization. Another side of the institute's usefulness will be brought into prominence when its fellows enter upon their privileges. That these are sufficiently attractive may be gauged from the fact that more than a thousand candidates were elected at the last meeting of the executive council. The annual subscription entitles to free use of the reading and conference rooms and to admittance to the meetings held by the institute; while in the building itself rooms are set apart for their special comfort, much as in a club house.

EQUIPMENT AND COST OF THE INSTITUTE.

A building so vast necessarily requires an immense amount of machinery for purposes of lighting, heating, and lifting. The machine room contains engines capable of supplying electricity for the 1,200 small lamps and 100 are lights, and of driving hot or cold air through miles of piping. There are eleven lifts worked by hydraulic pressure obtained by pumping engines and power storage plant. The tanks for the water required in the building are placed in the three towers, of which the central will reach an altitude of 300 ft., while the flanking towers, only one of which has yet been completed, and which will have an exceedingly graceful appearance, will be 176 ft. in height. The estimated cost of those parts of the building which are for the present postponed, namely, the Great Hall, the West Stairway, the Library, the Conference Hall, and the two Colonnades, is £80,000, which will bring the whole expenditure on the complete building to about £360,000. Up to the present, £280,000 has been spent. The subscription list at the beginning of the year amounted to about £413,000, or $2,650,000.—*Daily Graphic, London.*

ELECTRIC LIGHTING OF PHOTOGRAPHIC LABORATORIES.

THE incandescent lamp is the ideal source of light for lighting the laboratory of photography. No other source is comparable with it, either as regards cleanliness or convenience of manipulation. However, we have rarely seen it applied except in a few large establishments in which, because of the general use of the electric light therein, it was not desired to make an exception for the laboratory lantern.

Is that as much as to say that this mode of lighting is not within reach of the amateur? An amateur himself, the writer can assert the contrary, and add that he has not the least intention to return to kerosene and candles, except for traveling. But we find that, in order to obtain from an installation of this kind all the satisfaction possible, it is necessary that the light shall be employed only intermittingly. This is almost always the case, however, for the amateur, who, as a general thing, takes but a few dozen photographs during the year. Were it a question of working in the laboratory all day, and of having a special installation for such work, we should be less affirmative. It is the eternal question of domestic lighting. An installation of batteries is capable of giving satisfaction when all the care necessary is devoted to it, but it is rare that one persists in employing it for a continuous lighting.

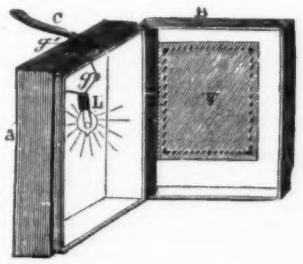
When it is a question of intermittent light, it is a very different thing, for we now possess sal ammoniac elements of the Leclanche kind, but of wide surface, which are capable of discharging a fraction of an ampere for nearly an hour, and consequently of supplying a lamp for the same time without an appreciable decrease in the electromotive force. These elements may remain mounted for years, the zinc not wearing away in open circuit. The sole precaution to be taken is to replace from time to time the water that has evaporated. It is well to inclose these elements in a wooden box, which will protect them from dust and at the same time reduce the evaporation. They may be mounted outside of the laboratory. If the distance does not exceed 30 or 40 feet, a wire 0·04 inch in diameter will suffice to conduct the current. A battery of five or six elements in tension is capable of supplying a one candle lamp, which is amply sufficient for all operations. One may employ a red globe, which will dispense with the use of a lantern. Green, yellow, and other lamps, too, may be found in the market, but, since colored lamps are slightly more expensive than those of white glass, these latter may be very well employed by inclosing them in a lantern that may be very rudimentary, for it is not necessary to make provision therein for the entrance and exit of hot gases. If such a lantern be so arranged that it can be opened, the facility will be obtained at the same time of illuminating the laboratory with white light.

The following are a few forms of lanterns that a person can easily construct for himself: The one represented in Fig. 1 is made from a cardboard box that contained 5×7 inch glass plates. In its cover, B, there is a rectangular aperture over which is fixed, by means of gummed paper, either a red glass, V, or a sheet of gelatine or paper of the same color. Upon the bottom of the box is arranged a lamp, L, kept in place by two drops of sealing wax that are allowed to fall upon the two wires of communication properly bent. These two united wires make their exit at C through an aperture in the cardboard that is afterward stopped up with a drop of wax, *g*. The box is closed and held by a rubber band. In the interior it suffices to paste white or tinned paper.

Fig. 2 represents a second form of lantern that may be suspended from the ceiling for lighting beneath, in such a way that the operator does not see the lamp. The latter is inclosed in a box, D, whose grooved cover, E, contains an aperture provided with a red glass. The conducting cord may be passed over a pulley to permit of raising or lowering the lantern.

Fig. 3 shows another style of apparatus a little less rudimentary. I is a red lamp provided with a screw socket. This lamp is mounted at the extremity of an insulating handle, F, and provided with an interrupter, S. The conductors may be seen at G. H is a ring that permits of placing the apparatus upon a table without the lamp touching it. This apparatus may be easily taken in the hand and held over the plate in order to examine it at one's ease during the development, and be carried around the laboratory in order to find something upon a shelf, etc. It will be well to silver half the lamp, so that one may not be incommoded by its brightness. In all cases, it is necessary to interpose in the circuit an interrupter placed within reach of the hand. In fact, when the plate is placed in the tray for development, it will prove injurious to expose it to the light. The latter is therefore extinguished, and a flash is given from time to time to see whether the development is beginning or what point it has reached. This method of procedure has another advantage, and that is that the observer's eye becomes much more sensitive, for it remains almost always in absolute darkness. When the lantern shown

FIG. 1.



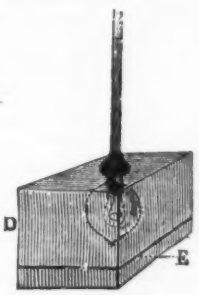
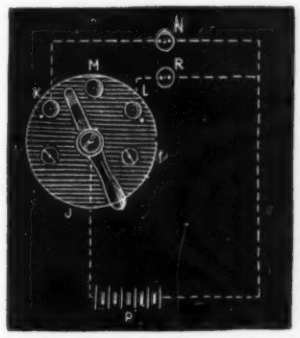


FIG. 2.

FIG. 4.



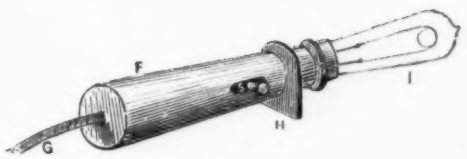


FIG. 3.

in Fig. 1 is employed, the box may be laid horizontally and placed over a glass tray to permit of watching the development by transparency without removing the plate from the bath.

Fig. 4 shows the interrupter, J, that we habitually employ for controlling a red lamp, R, and a white one, N. L and K are the two useful contacts. If these were placed near each other, it would frequently happen that the handle, on leaving the contact, L, would go to the contact, K, and the negative would thus run the risk of being clouded. The intermediate contact, M, prevents such an accident. Upon this latter may be branched a dark green lamp, it being possible to effect the development in green light without inconvenience; but we have hardly found any advantage in this method of procedure. *v* and *v'* are the screws that fix the interrupter upon the table; P is the battery.

This arrangement is likewise very convenient for the printing of positives by contact. After putting the paper in place by the red light, the exposure is given with the other lamp. We recommend especially for such use lamps of feeble voltage, that is to say, with short filament, because the luminous focus is of very small dimensions and consequently gives very sharp shadows. It follows that, even in case of imperfect contact between the paper and the negative, there will be no indistinctness upon the positive.—*F. D., in La Science en Famille.*

OAKLAND, SAN LEANDRO AND HAYWARDS ELECTRIC RAILWAY.

IN the year of our Lord one thousand eight hundred and ninety-two, on the seventh day of May, there were scenes of great rejoicing all along the way from Oakland to Haywards. Old Californians who had lived in the State ever since the exciting days of gold fever, and who were to witness for the first time in their lives the operation of an electric car, came from far and near to participate in the opening ceremonies of the new road. The event was a great success and the line entered at once on a prosperous business, paralleling as it does the Southern Pacific Railroad, and furnishing for the first time adequate facilities to a large territory, and at rates which have so largely cut into the local business of that steam monopoly as has caused the latter to curtail its car service and haul many empty coaches which formerly were crowded with passengers.

Owing to obstacles which were well understood to have been instigated by the steam road mentioned, it was at first impossible to place the Oakland terminus in the business heart of the city, and at this writing the electric cars start some little distance from the main street. Public clamor, however, became so strong that the desired franchise could no longer be denied, and the ordinance was passed and the line is now constructing which will give the cars the coveted access to the business district.

The road receives its name from the towns which it connects, and San Leandro, through which it passes. In the city of Oakland the route is along a magnificent residence street, on either side of which are elegant mansions, bordered with long rows of luxuriant palms and tall eucalyptus trees, whose straight, smooth trunks and fragrant leaves stand out clear cut against a panorama of orange, fig, and peach trees, and great banks of mammoth geraniums and rose trees, which latter energetically cover the sides of the houses and clamber high upon the roofs. Flowers in endless variety and profusion rise from well-kept lawns of richest green and mingle their perfume with great bay trees and stately cypresses. The whole picture is one of commanding beauty and loveliness, and furnishes a sight which alone many times repays the traveler for the necessary time to complete the trip. Passing out from Oakland, the overhead construction of which has been of cross wires and side poles for a distance of three miles, the route leads out along the San Leandro road, a public thoroughfare, on which center poles and brackets replace the cross wires. In the city the rail was a 40 pound girder; the balance of the way it is a tee rail of same weight laid on a splendidly rock-ballasted track, spliced with heavy fish plates, and smooth and firm enough to carry a fast express train. The cars, which were made by Carter Brothers, Newark, California, are mounted on Tripp roller-bearing double trucks, and are combination pattern. The inclosed body seats bear the well known name of Hale & Kilburn, Philadelphia, and are placed across the car, with a good sized aisle running lengthwise between. The seats are rattan, reversible and very comfortable. The greater part of the year the windows are removed entirely, converting the closed portion, which seats 20 passengers, into an open car. A platform at each end has side seats facing outward, the entire seating capacity of the car being 28. Notwithstanding the average speed is 20 miles an hour there is almost entire freedom from oscillation. Cars will soon be put on whose running time will be 30 miles an hour. There are at present 7 motor cars, and during the morning and evening hours, and when picnics are being held at any of the several resorts along the line, 5 additional open trailers are hauled. On Sunday band concerts are given and draw large crowds, who go out to enjoy the delightful air, the bright sunshine and the music.

Each motor car is driven by one 25 horse power Thomson-Houston motor of the W. P. type. With the exception of one grade, not exceeding 300 feet in length and having an ascent of only 6 per cent., the entire line is practically level, and was an extremely easy one to build, as it is now to operate. The route is through the rich valley cut up into fruit ranches, which, like a gigantic garden, stretch back to the foothills, a mile distant, while on the opposite side are similar ranches, with an occasional glimpse of the blue waters of the bay beyond. The entire length of track is 13$\frac{9}{10}$ miles, and the business between the towns named would not permit of sufficient revenue to make the investment largely profitable. But California "country" is unlike that east of the Rocky Mountains, and here 10 acres constitutes a good sized fruit ranch, 50 a large one, and the man who looks out over his 100 acres of prunes, pears, almonds, apricots and peaches is a genuine aristocrat. This division of small acreage per owner means a settlement which in population is very surprising to one accustomed to the many hundred acre farms of the Mississippi valley. These people, moreover, are as a rule well educated, great readers, and frequent travelers where facilities admit, and hence surprise soon vanished as to where

all the passengers were destined who filled the seats of the motor and trail cars.

On the public highway the track occupies 8 feet at one side of the road, in no way interfering with the team travel, and as cars are moved on as regular a schedule as steam trains, the meeting points at turnouts seldom cause delay. The motormen and conductors are bright, intelligent men, nicely uniformed and attentive. As the line is so long and a continuous ride all the way, it was necessary to adopt a system of graded fares, which are as follows:

Between Oakland and San Leandro, 15 cents; round trip, 25 cents.

Between Oakland and Haywards, 30 cents; round trip, 50 cents.

Between intermediate points, from 5 cents up.

Monthly tickets, good only for purchaser, are sold between Oakland and San Leandro for $3, and between Oakland and Haywards for $5. San Leandro is five miles from Oakland and eight miles from Haywards.

The power house is a neat, commodious structure of wood, located one mile from the business center of San Leandro. Here are installed and working beautifully two McIntosh & Seymour tandem compound engines of 140 horse power each. Steam is supplied from three Heine tubular boilers of 200 horse power each. Only two are in use, the third being kept in reserve. They are giving excellent satisfaction. Fuel used is coal. Two large T. H. generators are in service, but the station has been built so as to permit of doubling the number of engines and machines. The skeleton switchboard is well placed and conveniently arranged. Current is supplied to the trolley wire at intervals of each two miles.

At a safe distance from the station is the car house, also of wood, a neat building erected the present summer. It has a capacity of 24 cars, and at one end a room for winding armatures and a machine shop. The last car reaches the barn at 1:30 A. M.; first car out, 6 A. M.

Work was commenced in November, 1891, and carried on during the winter, numerous delays occurring owing to parts of apparatus failing to arrive, by being delayed *en route* from the East, but under the circumstances was pushed with very commendable speed. Frank M. Leland is the superintendent of the road, and a wide-awake, energetic man he is too. The construction was entirely in the hands of the Thomson-Houston Company, of San Francisco, and was personally directed by their resident engineer, F. F. Barbour. *Street Railway Review.*

PRISON REFORM.*

By TANCRED CANONICO, Senator of Italy.

IT is a matter of no small importance when so many persons from various countries, many of whom are eminent, are met for so important a purpose as the security of the public and the moral reform of criminals. But a special emotion moves our hearts when we see ourselves welcomed with such a splendid and cordial hospitality; when we see the marked interest in our work shown by His Majesty the Emperor, who has named as the honorary president of the congress a prince so intimately allied with the imperial family, whom I see with gratitude listening to my poor words, honoring the opening of our sessions by his presence and that of his august and gracious wife; in seeing ourselves surrounded by so many distinguished ladies, having at their head an imperial princess who has always devoted herself to improving the condition of prisoners, faithful to the noble and holy mission of woman, aiding by thought and action all efforts for the relief of the moral and physical miseries of humanity. By the union of so many brilliant attractions there is about us an atmosphere of heat and light which warms the heart and brightens the intellect. The most noble faculties are elevated by this inspiration. While I speak I shall feel this, but at the same time I shall experience a difficulty above all in presenting all I would say clearly in a language which is not my own. Consider then, I pray you, not the speaker, but the truth that is spoken. Reflected by the ocean or by a drop of water, the sun is always the sun.

I. THE ORIGIN AND DEVELOPMENT OF PRISON REFORM.

From the remotest ages criminals have been punished; but in different epochs how differently has punishment been regarded! It is this slow and continual transformation in ideas regarding it which, little by little, changes penal laws and suppresses old systems. Let us follow with a synthetical and rapid glance the gradual change of ideas, and we will have the key to the present prison system. Punishment, regarded from a broad point of view, is not alone endured in prison. We can truly say in this respect that the entire world is a great penal establishment. What is man here below and what does he not suffer? And all suffering, which is only punishment—mark it well—is the consequence of errors or faults committed by ourselves or by generations that have preceded us. The history of each people and of each individual is identical.

Each man suffers his own secret punishment, be it great or small; but it happens only too often that serious misdemeanors are committed that injure others and imperil the safety of society. Then the social power, in subjecting the guilty to a treatment more or less severe, only makes itself the organ, so far as necessary for the public safety, of this general inherent law in the constitution of human nature which, for each deviation from the right way, provides a punishment as a sanction of the true way and as a call for reform. And the treatment of criminals varies not only according to the gravity of the crimes and the guilt of each, not only according to the difference of circumstances, but also according to the idea with which each epoch and each government establishes its penalties and executes them. Every modification in the general idea exerts its influence on the conception of the punishment which should be inflicted on criminals, and consequently on the mode of application.

In the earliest times all suffering and pain was supposed by men who attributed to divinity their vices and passions to proceed from the vengeance of the gods, as a fixed destiny from which men could not escape. In this way even Aristotle regards it as an inevitable necessity that some men should be free and some should be slaves. A heavy and sad atmosphere weighed as lead upon poor humanity. According to the ancient Greeks, fate was superior to the gods. There was no place for the free judgment of man. Fatalism was the essential character of paganism. It is so in our day with the belief of the Mussulman and the people of Asia in general. This common conception of the penalty to be applied to the punishment of the guilty is converted in time into a sentiment of revenge by society, with the most complete indifference as to the condition of the criminals. The sentiment of justice and the influence of religion modified in some respect this cruel indifference. But it was always a justice purely exterior and coarse, taking account only of the apparent and sensible manifestations of criminal action. Hence came the law of retaliation, so general in ancient times, "An eye for an eye and a tooth for a tooth."

But suddenly, in the midst of the somber skies, a comforting ray shone on this unfortunate earth. This celestial ray awakened in the soul the faith that by suffering we can expiate crime; that by suffering man can redeem himself, because suffering enables him to look within his heart, to detect his errors, to detest them and to repair them, and in that way to remove the evils which have been caused by them. Through this belief a new impulse was given to the mental activity of man. In the midst of his time-worn grief, the poor exile on the earth feels reviving hope. From the depth of his soul he lifts a sigh to this beneficent ray; his heavy eyes look up and are wet with tears. He begins to regain conscience with his moral freedom, as he feels himself delivered from the bondage of sin and passion. The true progress of the people begins thus with the moral advancement of the individual. From that time punishment begins to develop into repentance. This fruitful transformation elaborated itself during long ages, and continues to-day in the heart of humanity. It has produced, little by little, corresponding changes in many manifestations of social life. There were those upon whom this principle took strong hold for the exclusive object of the moral perfection of themselves and their fellow men. From this class sprang the anchorites and monks, who were only voluntary prisoners; from these the fastings, the mortifications, and the religious penances.

In private life how many griefs are solaced, how many hearts are made glad and revivified by this belief! By it even in the masses of society manners are insensibly softened. We see there hereditary enmities end by a solemn peace. Vengeance is tempered by justice, and justice allies itself to clemency.

Sovereign pardon corrects the errors of human justice. The ties between master and slave become less hard, and little by little slavery falls, as the progress of the inferior class advances, and as the conditions of each country permit. The inequality which exists between men is in the nature of things and will always exist. But this inequality will be no more guarded by an impassable barrier. Each raises or lowers himself in social order according to his skill, his work and his merit. The abolition of serfdom in this great empire, accomplished in the midst of so many obstacles, is not the least glory of the reign of His Majesty Emperor Alexander II. The difficulties which accompanied and followed this step are inseparable from all great reforms. But they disappear under the action of time, of prudence, and sacrifices, which are necessary in the accomplishment of all real good.

In the meantime it has required centuries to develop the idea of the application of reformation in prison management. When that time arrived, the places of punishment began to be called penitentiaries, and the system was called a penitentiary system, the combining of different methods by which an attempt was made to apply the idea of expiation to punishment.

It is not necessary to follow, even in a summary manner, the historical development of the penitentiary system, nor to present a view of the different methods at present existing in the different States; for, on the one hand, such a review would surpass the limit of this meeting, and, on the other, as I address those who know more than myself, I do not desire to abuse their kind attention by useless details. It will suffice to recall by reference the most salient points of the development of these methods, which will be strictly necessary in order to draw some practical conclusions.

The saddest and most glaring fault of ancient prisons being the massing of prisoners in common, the first thing considered was their separation.

In 1677 the Abbe Francis established at Florence a correctional prison on the cellular system. William Penn had already proposed prison labor, with enforced silence, but the principle had not been applied.

The first serious attempt at prison reform is due to Pope Clement XI. In 1703 he constructed in Rome the prison of St. Michael, which is a vast parallelogram, with cells on the two long sides. By separation, education, and moral and religious instruction, they sought to bring back the prisoners to the right road. The words cut in marble, which can be read to-day, "It is a small thing to restrain the wicked by punishment if we do not reform them by a good discipline," contain the essence of all penitentiary reform; so that the construction of this edifice presents the first type of all buildings which, with successive improvements, have since been erected for this purpose.

Maria Theresa, Empress of Austria, followed this example in the prisons which she built in Milan and in Ghent in the second half of the eighteenth century But these reforms soon found enthusiastic followers in England and America, where the writings of Howard (of whom Mr. Spassowitch presented to us yesterday so living a picture) on the unfortunate condition of prisons and prisoners deeply moved the minds of philanthropists. By the law of 1785 the construction of a cellular prison in Gloucester was ordered, but it was, above all, in America that, under the name of penitentiary system, the reform of prisons assumed a great development.

You are aware that the Society for the Relief of the Unfortunate in Public Prisons (a prisoners' aid society), founded in Philadelphia by the Quakers, began by obtaining some mitigation in corporal punishments and the substitution of imprisonment for execution in some cases, the improvement of Walnut Street prison, and by classifying the prisoners according to the crime committed, and in confining the greatest criminals in separate cells. The example has been followed by many American States. It is scarcely necessary to recall the fact that from 1821 to 1829 there was built in Philadelphia the famous Cherry Hill prison, with nearly 600 cells constructed so as to render communication between prisoners nearly impossible. The isolation is continual. It is modified only by the visits of persons who can aid the guilty in their moral reformation. In Auburn there is established, as you know, isolation during the night, and work in common during the day, with compulsory silence.

The several States of the Union have generally adopted one or the other of these systems. In Virginia the Philadelphia system has been adopted for the beginning of the punishment and the Auburn for the succeeding period.

There was an attempt to introduce the two methods in Millbank prison, in England, which was constructed in 1812. Subsequently cellular isolation prevailed there, with some alleviation; a system which was also adopted in Pentonville, inaugurated in 1864. The two systems were likewise attempted in France; the cellular in the prison of Roquette and the Auburn in the central prisons of Montpelier, Fontevrault, and elsewhere. I cannot recall the prisons of France without rendering homage by an affectionate and grateful word to the illustrious Charles Lucas, whose recent loss we deplore. From his youth he powerfully contributed to prison reform, and to the last days of his advanced life he fought for humanitarian reform with all the vigor of a young man. Like a brave soldier, he died in the breach. I was honored by his friendship. It is a very sweet duty for me to present here this flower of affection and memory.

Belgium, the different states of Germany, Holland, Sweden, Norway, Switzerland, Russia, Italy, Spain, and Greece have followed with ardor this reform movement in its different manifestations. We have all admired, during these days, the prisons of St. Petersburg. The new penitentiary near the Alexander Bridge, over the Neva, known as the Viborg or new prison, is, without doubt, one of the finest prisons in Europe. The progress made here is striking; above all, since ten years ago, when this branch of the administration was united under one direction, the exclusive jurisdiction of the minister of the interior. It is an honor to the imperial government and to the illustrious and eminent officer (Mr. Wraskoy) who has the general direction of the prisons of the empire.

How remarkable that the development of the idea of repentance in the organization of punishment resulted in two prison systems corresponding to the two principal religious orders in which the growth of this same idea produced the system of voluntary repentance, so that Leon Faucher has said with reason that if the world were divided between two prison systems, as it was formerly divided between two great religious orders, it could be said that the Philadelphia system is that of the East and the Auburn that of the West. In the equal development of the same principle applied to two different orders of institutions there is an inward law of human nature that it might be interesting to investigate. But the mind of man is so constituted when it has taken a new direction it does not stop so easily. It was soon perceived that neither of the two systems had an absolute value, and neither was exempt from inconveniences. We have seen that in Virginia they had already attempted to unite the two systems by limiting the first part of the punishment to cellular separation. The necessities of colonization in Australia have suggested to the English the idia of the conditional discharge of the prisoner toward the close of his confinement, a discharge always revocable in case of bad conduct. This practice has since been introduced in the system of ordinary punishment. It is thus that the English have begun to distinguish three degrees in temporary punishment—cellular separation, work in common, and conditional discharge.

But Mr. Crofton, whose name is an eulogy, in his work as a member of a commission of inquiry upon the state of prisons in 1853, was impressed by the disorder he found in most places, and he felt profoundly the necessity of an intermediate period of transition between that of work in common and of conditional discharge. The English government consented to make an experiment in Ireland, and after the good results which followed, it regulated later by an act of Parliament the system which is called the Irish.

I do not need to address you on this system in detail, which you understand better than I do. It will suffice to recall that after a period of isolation, where by exclusive contact with reformatory influences they attempt to arouse the conscience of the criminal and to lead him to a firm resolution to live honestly, the prisoner passes to a second period of life and labor in common, where the convicts are separated into different classes, according to their conduct.

Then come the intermediate establishments, where the convict puts off the prison uniform; where, according to his ability, he is given agricultural or industrial work, where he begins to have contact with persons outside, in order to become acquainted and more readily find work when his sentence has expired. A special school is organized to prepare the prisoner to use his liberty well, to show him how to employ himself, and to overcome the difficulties which will meet him on his return to liberty. Finally, in the last period of his term, comes conditional discharge.

The essential principle of this system is that the convict, having passed in each degree a minimum of time, it depends on his good conduct to raise him to a higher degree; and, on the contrary, he can by bad conduct retrograde from each degree to a lower.

Every one knows the excellent work of Mr. Vander Brugghen on this system. It is impossible to begin reading this work without completing it, such is the interest that the system itself awakens in the reader and such is the love with which the author treats it.

This system has a double object, to individualize as much as possible the application of the punishment adapted to each convict, and to prepare every one, little by little, for a free, industrious and honest life.

The fundamental idea of this system responds at the same time to human nature (*non procedit per saltus*)

* Address at the Fourth International Prison Congress, St. Petersburg, Russia, 1890. C. D. Randall's Report, Circular of Bureau of Education, No. 2, 1891.—*The Sanitarian.*

and to the purpose of punishment, which is the safeguard of public security, returning to free life men capable of work, disposed to labor and of good conduct. It is not surprising, then, that under different forms this idea has considerably extended and has modified in this way the prisons of different countries. With the exception of perhaps Belgium, where the cellular system during all the imprisonment gives good results, I believe there is not a state in Europe where isolation is exclusively adopted.

At the side of prisons of continued isolation, which are becoming more rare, we see rising everywhere prisons with a graduated system. In Italy, after some happy efforts with labor in the open air for the least dangerous among the convicts, all have adopted in the new penal codes the graduated system for long punishments. We have also introduced it in the military penal code, which is at present being studied as much as the nature of military institutions on land and sea will admit.

In extending this principle further, in some states they began to establish conditional punishments for offenses of less gravity; that is, the condemned undergoes the punishment only after a second conviction.

With regard to judicial prisons, as they are for a detention which should be brief, applied to the accused whose guilt or innocence is not determined, and during which time it is for the interest of public justice, of public safety, and human dignity, that there be no communication between those who are real criminals and those who may not be, every one agrees that the only just and rational system is that of continued cellular separation, although the need of sufficient establishments and financial difficulties prevent, in more than one state the entire and complete application of the system.

It is hardly necessary to add that when once the idea of reformation enters the penal institution, then comes the desire either to prevent crime in cutting off its sources or to hinder as far as possible the relapse of the criminal on the expiration of the sentence. Hence come the reform schools for the young and societies of patronage. Concerning these complementary institutions of prison reform, the first of which in our days has had a great development, I cannot speak now, for they furnish sufficient material for several conferences.

After this summary view of the origin and development of penitentiary reform, I request you to follow me for a short time, so that we can together grasp the essential unity of the subject. We can the more easily appreciate the good results which have been obtained, distinguish what is to be avoided and what is yet to be accomplished, so that if we cannot fully attain the object sought, we can approach it more and more.

2. THE ESSENCE OF PENITENTIARY REFORM.

I consider only those fundamental principles that are common to all systems, and I understand that the essential unity of prison reform, whatever may be the manner of its application, consists in removing whatever the ancient prisons possessed of cruelty, antihygiene and immorality, and to make the punishment serve for the reform of the criminal. And I ask, in pursuing this noble end, Have we not lost sight of the true object of punishment? And in applying this principle are the means employed adapted to gain the real reform of the guilty?

Observe, then, in what manner we may derive profit from the rapid review we have just made of the prison reform movement. Consider well the subject upon which I shall address you a few moments longer, if you will give me your kind attention.

The condition of ancient prisons, the treatment and nourishment of prisoners, and their idle congregation were without doubt highly contrary to the health and morality of the prisoners, and consequently to the public interests and social security.

Desiring to remedy these evils, we often fall into the opposite extreme. We have so elaborately attended to the buildings, the cells, the food and the treatment of the prisoners that many workmen who labor from morning to night to give a morsel of bread to their families, if they knew how they would be treated in certain prisons, they would perhaps prefer —in all save crime—life in the prison to that in their sorry attic.

In some places they are so occupied in perfecting their prisons by the best methods of ventilation, heating, pavements, furniture, locks, supervision and a thousand other details that the essential end of reform, the conversion of the guilty, has imperceptibly passed to a second place. On the contrary, pushing to the extreme the principle of moral reform, it is claimed that so long as the prisoner is unchanged he should remain in confinement. It would be useless, they say, to propose the release of the guilty before the reformation is complete, and the punishment would not be effective, even for public safety, if we returned to society a criminal who would commit new offenses.

In the mean time the great public, seeing these exaggerations, and not seeing much good fruit in those who go out from the prisons, noticing at the same time the increase of crime, and that crime is frequently a profession, the exercise of which is only interrupted from time to time some months of the year when the offenders are in prison, cry out, smiling, that all this is but a Utopian theory, pity for rascals to the detriment of honest people.

On the other hand, the positive school, of which the essential principle is fatalism, founded upon the conditions of a man's organization, innate or hereditary, upon his social surroundings; the locality of his birth and education; upon the impelling causes that determine his actions; sees in all these efforts for the moral reform of the prisoner only the dream of visionaries. And if, in view of public safety, we occupy ourselves with the regime of prisons for the benefit of individual convicts, they see in the criminal only an invalid or an idiot for whom the hospital rather than the prison is the more suitable home.

And, after all, on which side is the truth? I will first say that I am not one of those who despise as folly the influences exercised on the moral tendencies of man, the condition of his organization, the society where he lives, and the circumstances in which he finds himself.

So considerable a part of the human being as is the organization of the body, which is the covering and instrument of his activity and moral actions, cannot be set aside when we must estimate the moral value and the imputability of his actions. Two horsemen equally competent in horsemanship can mount, one an excellent horse and the other a sorry jade. If I am obliged to live in an unhealthy place, no one can consider it a fault on my part if I am not as well as he who breathes with full lungs the pure air and oxygen of the mountains.

The influence even of the bad horse can be such that every progressive movement is impossible; and the influence of a sickly climate can sometimes force me to take to my bed.

Now, all this can prevent the man from acting with entire freedom, but it does not destroy liberty itself. It is only necessary to say that it will require great care to secure utility from a poor horse or to overcome, at least to some extent, the deleterious effect of certain atmospheric conditions.

Moral liberty, though narrowed in its exercise, always exists, though at times dormant, and by proper management and more vigorous efforts it can, to a certain extent, overcome these obstacles. Now, it is upon this slight liberty we must act to secure the improvement of the guilty. We tame lions; we can as well tame men.

I will say, in the second place, and I say no new thing, that the ancient prisons were frightful and unhealthy habitations, where the criminal stagnated in idleness and filth, where he was poorly fed, and was under the arbitrary power of guards and directors. Now that he has a proper prison and healthy food, obligatory labor and good discipline are not only just, but necessary, in the interest of the criminal himself and for that of the public. For, aside from the consideration of the fact that under certain circumstances the unhealthy prison can easily become a center of infection, it is evident that, if the punishment is completed, you return to society a miserable invalid, incapable of earning his bread, and in addition to the obstacles which encounter each discharged prisoner he will find the greatest yet—his inability to get work, which, nine times out of ten, will cause him to commit new crimes. Besides, a good hygienic treatment, while improving the physical condition of the prisoner, renders him less irritable and predisposes him to mental struggle to improve himself morally. But every one can see that this self-treatment is powerless to secure the complete reform of the prisoner.

Humane treatment is necessary in order not to destroy or degenerate his vitality. At the same time, we must never forget that according to the immutable law of our being, every penalty entails suffering without which man will never apply himself to the practice of virtue for which his natural inclination is so feeble. By it he will see it is for his own good interest to become good, that the suffering may cease.

Finally, it is necessary that the condemned endure suffering in order that the punishment be withdrawn. He should not be treated with cruelty, but he should feel the pain. I will say that the reformation of the guilty, considered in itself, is a thing to be regarded as sacred and the surest guarantee of public security, but it must not be forgotten that it cannot be the direct end of punishment, however desirable it may be. Society should aim, above all, to repair the injury done by crime, and for that purpose it can do nothing better than to proportion each penalty to each crime. During the execution of the sentence as much as possible should be done to reform the prisoner, but when the term is ended society no longer has the right to retain the guilty in prison until his reformation, otherwise society becomes an agent for morals and education only. Proportion between offenses and penalties would then be impossible, since even for the smaller offenses, if the delinquent is not reformed, he might be retained in prison for years and perhaps always; and, on the contrary, after some months, or even weeks, the greatest criminals could be discharged if they show by their conduct they had reformed. That some endeavor to correct delinquents during their sentence and prevent relapses is very well, but to go further would be to misunderstand the character and limits of the punishing power of society.

But even in thus placing penitentiary reform upon a true basis and within true limits, a grave and final question remains to be answered. With all this help, can we reach the reform of the criminal?

A man, although a criminal, does not cease to be a man. He is then subject, as well as the man generally regarded as honest, to the proper laws of human nature. I recall with tender emotion what was said to me some years ago at Christiania by an excellent director of the prison, loved by all who knew him—Mr. Petersen. "They speak to me of criminals," said he. "I am a criminal myself; for if I sound the depths of my soul, I see there, in germ, the same crimes which are punishable in prisons. Only education, religion, the love of good, the struggle against self, have prevented the germs from developing and producing bad fruit." What Mr. Petersen said, each of us, if he is sincere with himself, is obliged to say. Then the treatment to apply to the reform of the prisoner is at the bottom the same as for the moral amendment of the free man, but there it is necessary to apply it more rigorously and with energy, on account of the greater obstacles arising from vicious tendencies and inveterate habits.

For the efficient treatment of every malady three things are necessary. First, that there be a remedy having intrinsic curative powers. It then follows that there should be a qualified physician who can apply the remedy to the individual case, and finally that the sick should accept the remedy. Without these conditions no cure is possible.

Now the same thing occurs in the case of the morally diseased. For the criminal the first efficient remedy is to arouse the conscience. In this he is aided by the recollection of his offense and made to feel how repulsive is crime and how beautiful is a virtuous life. This aids him to eradicate those vicious tendencies that result in crime, and to approach the ideal of a better life. In this movement is the essence of the remedy and secret of reform. Then follows improvement of the morals, which is best promoted by religion, of which all men who know little or much of prisons and prisoners know the beneficial influence. The physician is, above all, the director of the prison, and he ought to be. Entering with a loving and devoted spirit the place of each convict, seeking to possess his confidence, laboring with each according to his disposition; better than any one else he can contribute to the awakening of the conscience. The pivot of prison reform is a good personal direction. But the most essential and difficult thing is that the diseased—that is to say, the prisoner—shall consent to take the remedy. If he will not take it, the fault will not be in the remedy nor in the physician, but in the patient himself. We build prisons, but what is most difficult is to introduce in them the spirit of penitence. For in the spirit of man—above all, of the man thoroughly degenerate—there is such a strength of resistance to reformatory influences that the best efforts fall as upon granite.

Whatever, then, may be the perfections of any prison system that can be conceived, it is impossible to say in an absolute manner that it will secure the reform of the prisoner, because there must be a responsive action in his own nature for which a good prison system prepares the ground, but no human power can of itself work the cure.

Now as a good general, having met great resistance from the height of the fortress he has attacked, seeks to enter by a more accessible passage, this inward resistance which is met in consummate criminals has in these days aroused concentrated efforts for the reformation of the young, it being more easy to arrest vice before it has become crime. In this generation there has been an evolution in penal science analogous to that in medicine. Formerly the physicians treated only the exterior morbid phenomena and applied the remedy to the surface, not preventing the reappearance of the disease. Then began the study into its causes and sources, and the search for suitable remedies. But in time it was noticed that the source of the disease was often from within, and the consequence of habitual ill treatment of the organization in defiance of its natural laws and sickly tendencies, hereditary or acquired. They then occupied themselves in devising a more rational régime to maintain or establish the normal and just equilibrium of each force, of each faculty, and of each organ. Medicine thus gravitates now to hygienic principles. The same evolution applies to the idea of reform as connected with the punishment of the guilty. At first only the gravity of the injurious results of crime was considered, and they inflicted corresponding material punishments, cutting off the hand of the robber or decapitating the murderer. Passing later to consider in each case the circumstances of the crime and the degree of guilt chargeable to the criminal, they began to proportion the severity of the punishment to each case and to each individual. They thought finally to occupy the time of imprisonment for the moral reform of the prisoner; and hence arose penitentiary reform. At present, seeing the difficulty of the reform of adults, they strive to correct the vicious youth before they become offenders. Thence comes the development of progress in these later days in houses of reform. Behold thus hygiene in penology, which tends to render the employment of remedies less necessary.

The tendency of modern legislation toward the mitigation of punishments requires more energetic action for prevention. In reform schools lies the hope for the moral reform of the dangerous classes. I dare hope that prison reform, if it shall produce no other benefits, will do immense good by leading many eminent men to direct their efforts to the reformation of criminal youth.

In the meantime we should not neglect to do all that may be to reform the guilty whose sentence has expired. Whatever importance is attributed to hygiene, the physician who does not aim to prevent disease, and who does not wish to treat the sick, however incurable the disease, is not a good physician.

First, the means employed to reform the criminal do not always fail. There are some prisoners who reform themselves, and there are sick who heal themselves.

Besides, should we renounce all efforts for reform when we cannot always succeed? As long as there is life there is hope, and this hope should never be renounced. Moral improvement is ordinarily very slow, but the true aim of all progress is not to reach the end at once, but consists in a constant advance. The regenerating inspiration which has made suffering an instrument of moral redemption is born of love. And love is never discouraged. When we succeed in producing with a few only of the hardened criminals a real abhorrence of evil and love for the good, do you believe it would be time lost?

It is no small matter to impress on the most degraded of society this principle, superior to all differences of nationality, customs and opinions, to which all hearts aspire: the moral redemption of man and of humanity.

But this moral redemption began in the world by a power from on high. We should then have faith that a day will come when evil will be vanquished, when truth, justice and love shall reign here below for the consolation of this poor earth.

ACTION OF NITRIC OXIDE UPON THE METALLIC OXIDES.

By MM. PAUL SABATIER and J. B. SENDERENS.

IN a former communication the authors have shown the action of nitric oxide upon metals and upon the lower oxides capable of being peroxidized. These results, completely different from those produced by oxygen, or by the air, show that nitric oxide has a peculiar oxidizing power. The study of its action upon the peroxides shows that it may also act as a reducing agent. The reduction of chromic acid begins at the ordinary temperature. Silver oxide is not resolved into its elements if heated below 200°, but nitric oxide reduces it at 170° and upward. Lead peroxide, PbO_2, if heated alone, is perfectly stable below 450°. Its decomposition takes place only at a red heat, and it then yields orange minium, which, on prolonged ignition, is converted into yellow litharge. In nitric oxide the reduction commences about 315° and proceeds regularly at this temperature, yielding at once white litharge, perfectly homogeneous. Manganese dioxide, which evolves oxygen only at a red heat, acts upon nitric oxide at 400° and is converted into brown sesquioxide. Nitric oxide may be utilized in the production

of nitriles. The oxide to be experimented upon was suspended at first in deaerated water by means of washers, traversed at first by a current of hydrogen. Nitric oxide absolutely free from nitrous vapor is then directed upon it, when there is an exclusive formation of nitriles.—*Chem. News.*

HIRAM SIBLEY.*

THE world honors men who have inaugurated great enterprises; it doubly honors men who have made great beginnings of grand social movements. Hiram Sibley was one of those who first and most effectively aided Ezra Cornell in his great beginning of a grand educational evolution. Hiram Sibley shares with Ezra Cornell and his coadjutors and successors that honor which is perpetuated and symbolized by the material part of Cornell University, and it is fitting that he should be given a monument in its chapel, in presence of that erected to the memory of the founder. This would be true had he done no more than promote so well the general welfare of the University in which he came to take so great an interest; but the man who helped make the fortune which the founder so greatly imperiled later in the effort to sustain his splendid enterprise; the man who aided so efficiently in making it possible that Cornell University should be founded; who stood hand in hand, shoulder to shoulder, with the founder during his life, and who, after his death, still more effectively promoted the noble work so well begun—this man had his own peculiar and noble work to do.

He was to make the real beginning of the new and special "liberal and practical" education, for the privilege of promoting which Cornell paid his half million dollars and founded his university. He was to enjoy the privilege of inaugurating an important branch of that education of the "industrial classes" which this University was founded especially to promote, and which it has become famous for having so well illustrated in its short life of a quarter of a century. It is this which constitutes the great beginning of a great work and which gives Hiram Sibley claim to highest honor. He began, and began well, a noble enterprise for which the world had long been waiting, and which, once inaugurated, was certain, in such a location and under such circumstances, to grow in magnitude and usefulness as long as the fundamental purpose and the aspirations of the founders of the University should be remembered. The bust in the chapel of Cornell University is unveiled as a testimonial of the respect and affection of his colleagues and of the authorities of the University. It will stand unchanged through the centuries, and through all the long years will remind coming generations of students and teachers of their benefactor, and give strangers some idea of the sturdy form and rugged features of the man who gained fame and honor as the organizer of a great telegraphic system, but a fame eclipsed by the brighter glory of the builder of a college for the education of the sons of the people. After all, the real monument is not bust of bronze or limned portrait; nor is it buildings and apparatus of scientific research or of practical work that will most permanently give this man his fame. It is the commencement of the work that constitutes the claim; it will be the constantly growing and never-ending good that comes of it that will raise a monument of constantly increasing magnitude and never-ceasing utility, beside which portrait, bust, or grandest structure will be of little worth.

Aristotle founded a philosophy which is to-day of the past; but the founder is honored by the greatest minds of modern times as a beginner. A great man saw his opportunity to make a beginning; smaller men complete his work. Herodotus wrote a history; it was a simply told story; but it was the beginning of history, and Herodotus still lives. Copernicus, in his knowledge of astronomy, was a child beside the student of the stars in our time; but he is immortal as the beginner of a true exposition. Newton began the development of the science of mechanics; his "*Principia*" is no longer known in the schools; but no more brilliant fame illuminates our modern time than that of the man who gathered these pebbles on the shore of the ocean of truth. Gilbert began a science of physics and Lavoisier a chemistry, innocent, both, of a knowledge of principles and facts familiar to every intelligent college lad; their names are forever famous. Linnaeus and Buffon and Lyell cleared the way to merely the portals of the paths of modern natural science. We honor them to-day. They will be honored so long as humanity shall move onward and upward. Watt built a first rude steam engine; Stephenson constructed the beginning of the railway; Morse employed Cornell to lay the first telegraph wire beneath the ground and built the first overhead line, roughly and crudely; but the flash of that first beautiful message, "What hath God wrought!" will be remembered longer than bronze or granite shall endure; Stephenson will never be forgotten and Watt will never need artificial buttress for his intangible monument.

Columbus discovered America; but his glory is not bounded by the narrow limits of Watling Island, nor is his memory lost in four centuries. Columbus discovered a world, gave foundation to a nation, made a history possible to peoples who, through all time, will remember him for his share in the beginning of such mighty possibilities. The voyages of Thorstein and of Eric were more hazardous than those of Columbus; the conquests of Cortez and of Pizarro were grander in themselves than the strifes of Columbus; the growth of the American nation is a more wonderful spectacle than the annexation of Mexico or of Peru to Spain; but the fame of the discoverer and the beginner of all that four hundred years have seen on this continent, and that the coming ages are to see, looms up out of the historical past in grander and grander proportions as the centuries go by. And thus it is with all famous men. Their fame is measured, not by the greatness of their exertions or of the work performed by them in their own time and by their own strength; but by the magnitude of the movement which they have begun, and of the results which follow in the years and the centuries which profit by their foresight and wisdom and self-sacrifice.

Thus is it here; and we honor Hiram Sibley to-day; not because he gave to Cornell University of his troublesome superfluity of wealth; not that he erected structures that his own State should have raised as her share of the great work inaugurated by the general government; not that he made it possible for the nation and the State and Cornell University to make good a promise to the people that neither the State would or the University otherwise could have at the time fulfilled, though the State had contracted with the general government to do so, and the University was ready to do all rightfully asked of it and that lay within its power. He did all this and more; but it is not all this that entitles him to our respect and these tributes. Contributing to Cornell University large sums of money; making it possible for her to place those buildings on her beautiful campus which were needed for the work to which she was pledged; giving opportunity to the sons of the farmers and of the mechanics of the State to secure the most practical and liberal education of the time; distributing libraries among colleges, giving schools to the South and the West; aiding the worthy poor in a thousand ways unknown to any one but himself: all these are admirable and beautiful deeds of righteousness; but while entitling the giver to love and honor, they are nevertheless not, in themselves alone, works which confer highest or most durable fame. We honor Hiram Sibley because, besides all this, he exhibited a foresight and a grasp in his plan which insured a future and continued growth of his beginning into mighty works for future days and generations. The world had just reached a point at which it was prepared to begin that newer development, in education of the people for the people's needs, anticipated by the wisest men from the earliest days, by Plato, by Aristotle, by Milton, by the Marquis of Worcester, by Comenius, by Richter, by John Scott

HIRAM SIBLEY.

Russell, and by Van Rensselaer, and Lawrence, and Sheffield.

When Ezra Cornell called his old antagonist in business, become his best friend, into the board of trustees of Cornell University, Hiram Sibley saw his opportunity and promptly seized upon it. He took as his share of the work the foundation of the Sibley College of mechanical engineering and the mechanic arts. He stepped into the place of honor and accepted those duties which the State had failed to perform; and Sibley College became the root and the sustaining trunk of an enterprise of such importance and of such possibilities as even the wise man who founded it probably little realized, even though before his death he had the pleasure of witnessing its first great expansion. In this splendid work Hiram Sibley had an earnest coadjutor in John L. Morris and his colleagues. He gave the seed, directed its planting, and provided for its cultivation; they did work which fell to them to do, and that beginning was thus made for which we here and now praise and honor the wisdom and liberality of the man who made it all possible at that time and in this place. He was happy in his opportunity, wise in his recognition of it, prompt and forceful in his seizure of it, liberal in his development of it. We are, even now, but beginning to see what that noble work may, if carefully and wisely promoted by his successors and theirs, become. It may easily be made to give to Cornell University the high privilege of becoming the center, for the United States, at least, of all educational work in these latest departments of a "complete and liberal" education; it may yet bring her the distinction, the highest of modern and coming times, of here becoming the mainspring of advances in applied science, the source and the support of the grandest developments of modern life.

Hiram Sibley lived to see this seed take root, to see the germination of the plant, and to witness a growth far beyond the limits which had been anticipated by him as possible within his lifetime. He saw it become a sturdy sapling; we have seen it within these few years grow to the altitude and the amplitude of a healthy young tree, splitting its bark in its rapid development of new leaves and fresh twigs and wide-spreading branches and swelling trunk. But not the foresight of the founder himself, not the best judgment of his wisest successor, shall say where or when its growth shall cease, if well cared for. Give the young tree room for growth, a wholesome soil, and a healthy atmosphere in which to expand, and its best friends shall be astonished by its continued rise and spread, and its most earnest detractors shall be converted to admiration and to helpful sympathy by its good fruits and healthful influence.

Its roots and its branches already need more room, the soil is good and the atmosphere better than is usual; but more space, further enriching of the soil, more room for the branches, and a still more healthful atmosphere are to be hoped for. These given, the value and the magnitude of Hiram Sibley's gift to Cornell University, to his State, to the nation, and to the world, will never cease to impress more and more every friend of technical and liberal education with its usefulness, its importance, and its growth in all that constitutes a real basis for the fame of its founder.

Sibley College began twenty years ago as the germ of a struggling school of the mechanic arts, a higher sort of manual training school appended to a mixed course of instruction, neither an educational course nor a technical course in the full sense of the modern terms. Its students, half educated, half trained professionally, went out into a world less educated, less well trained, and made their several marks with force and decision, and began effectively to build up the reputation of their teachers and their alma mater. Seven years ago its progress was such as to justify its organization into a technical college of the highest type, and in three years more it had outgrown its boundaries, and its founder had the satisfaction of seeing it necessary to limit the entering classes while awaiting enlargement of its buildings. This done, he saw, before his death, in the following year, a renewed growth of unprecedented rapidity. The course had, meantime, been made a professional one, with work at least a year above that ordinarily given in such courses, and such that graduates of technical schools in good standing find a full year often necessary for satisfactory prosecution of their work for the first degree.

To-day, this memorial of our friend, of the founder of Sibley College, is placed in presence of a hundred young men prepared to graduate from among five hundred beneficiaries of his noble work. The buildings erected by him, extensive as they are, are more than crowded with students, and double their capacity would be none too much for the coming years of this decade.

They are filled to overflowing with the most extensive equipment of its kind in the world, given by Hiram Sibley, by a hundred friends of his enterprise, and by his appreciative successors; yet double this unique outfit could well be utilized to-day, and no one can say what opportunity may come for still larger extension. A hundred farmers' sons, a hundred sons of mechanics, hundreds of the most ambitious of the young men of the day, are flocking to share this bounty. Hiram Sibley has indeed made a grand beginning, and it now remains for the nation, the State, and all the friends of this the greatest of the great social movements of our time to fittingly supplement his work.

This great work has another aspect still, which makes it a source of higher honor to Sibley and to his coadjutors than even that which we have just viewed so briefly. When the young senator of the State of New York accepted the first presidency of Cornell University, he came, not to do the routine work of the college president of a long established and slowly changing institution of classic learning, great and honorable as that grand work unquestionably is. He sought not the opportunity of promoting "the liberal and practical education" of the "industrial classes" alone; novel and mighty and attractive as such work must have been to every statesman and every thinking man of his time. He came to aid Ezra Cornell in organizing a "people's university," in the sense that it was to be a real, an all-embracing university, offering all the elements of complete and perfect education to all classes of people. He came to perform his splendid part in the erection of a true university; the like of which had been dreamed of, in misty and undefined form, by many a great soul in earlier days, but which had never before become concrete. This was work for a president of a great university that might well attract any patriotic, wise, and far-seeing man from even a greater work than that of making laws for the State or even for the nation.

When Henry W. Sage built the Sage College for Women, he added another element which brought Cornell University more nearly into perfect and complete form, which gave more nearly perfect symmetry of organization than had been attained by any earlier structure of this sort in the history of the world. When the same strong hand aided the university in its upbuilding by the erection of the Sage School of Philosophy, it was but another and grander approximation to that perfection and completeness. When the same hand, so often before working with White and Sibley and McGraw, in a common and glorious task, erected the library which stands, as a magnificent memorial of good, sought to be done, in the midst of these great buildings and on the edge of our beautiful campus, he gave a great and radiant center to the complete system which was gradually becoming evolved from the earlier educational chaos.

The enlarged departments, and the growth of the material and visible university, under the skillful guiding hands of the newly adjusted administration, promoted by the unprecedented labors of a still too small faculty, came forward with astonishing rapidity to give example to the world of that Miltonian education which the blind poet dreamed of as "complete and perfect."

How great the work here so well begun may be inferred when it is said that, to educate the existing body of American youth, as well as portions of the world are already prepared to educate their coming men, there should be founded, in the United States, to-day, no less than twenty technical universities, fifty trade schools, and two thousand high schools, including manual training and the "*slojd*" systems in their curricula and preparation; while two thousand professors, with twenty-five thousand students, twenty

* An address delivered by R. H. Thurston, Director of Sibley College, Cornell University, June 15, 1892, on the occasion of the unveiling of a bust of the founder of that institution, in the chapel of Cornell University.

thousand teachers and a half million scholars, should be receiving these untold blessings. A million boys are now growing up, needing and rightfully demanding of the nation this privilege of a complete and perfect education for their coming lives. The opportunity is still boundless, and many Cornells, many Sibleys, and countless lesser benefactors, are coming forward, in the early future, to seize each his share; but these men who made the beginnings are those who will be longest and most honored.

Millions will, in future years, be contributed to the purposes of Cornell University; but the first $25,000 that Ezra Cornell paid for the privilege of giving to the State of New York his first half million will count for more than all. New schools will be added to old schools, and the university will be thus expanded to cover the world of culture; but their builders will not be rated with Columbus. Presidents will come in long procession as the centuries pass, but they who head the line, though the most distant of all, will be best remembered as the inaugurators of the work. Buildings will rise about these lovely lawns, and among the fields beyond; but the pioneer builders are those to be longest famous.

The founder of Sibley College, as one of the vital organs of the great body of Cornell University, gave hundreds of thousands of dollars to the cause of education here and elsewhere, millions, very likely, to unnumbered and unknown charities and philanthropies; for that generous disposition of the fortune intrusted to him we give him due credit. He gave a mass of buildings and a forest of tools that the purpose of the university and the aspirations of its founder might be, to that degree, satisfied; for this his name is made for all time a household word among the youth of coming generations. He gave time and thought and earnest support and wisest counsel to the conductors of this mighty enterprise; for this he is entitled to the gratitude of every friend of the people, of every friend of every phase of education. But that which includes all and best entitles Hiram Sibley to praise, to highest honor, to most enduring fame, is that he made the grand beginning of a glorious and mighty work. It is as the founder, as the *beginner*, that so much of immortality as can be given by mortals is rightfully claimed for Hiram Sibley.

[Continued from SUPPLEMENT, No. 865, page 13827.]

THE LIFE OF DR. P. H. VANDER WEYDE.

AN AUTOBIOGRAPHY.

II.

THE natural toboggan slides which the several inclined streets of the city of Nymegen offered during a large portion of the winter season for the amusement and healthy exercise of her boys were far surpassed by what she offered during the summer season in the extensive defensive earthworks by which her walls were surrounded, and which were the result of an immense labor going on during many generations, being induced by its peculiar situation. Nymegen is the most distant city from the Alps which can be reached by marching armies without crossing a river, and this by following the roads along the spur of mountains which separate the watershed of the German Rhine and the French Meuse. A historical relic was many years ago fished up from the bottom of the river in front of the city; it bore the inscription, "Hic Pez Romani Imperii," "Here is the foot of the Roman Empire," and acknowledging its importance, it appears that the Romans were the first to fortify it, and there is no doubt that it is the Oppidum Batavorum mentioned by the Roman historian Tacitus.

These earthworks occupied for many centuries more space than the city itself, but the causes that their erection and maintenance were considered necessary were that the city was always considered to be a most important strategic point for the Netherlands, for defense against foreign invasion from the east and southeast (Germany), like Luxemburg, in Southern Netherlands (now Belgium), was considered and is still mentioned as one of the strongest fortified cities of Europe against invasion from the south (France).

At a distance of from five to ten miles southeast of Nymegen is an extensive arid plain called the Mookerheide, similar to the plains of Waterloo, and where in olden times battles have been fought, one of which resulted in a conference of the leading European powers in Nymegen in 1675, and later in an alliance between France and Holland against Spain, in 1678, by which the latter was forced to cede French Conté to France and abandon its claims to several important towns in Holland. This treaty is known in the history of Europe as the "Peace of Nymegen."

To make this important city impregnable for the means of attack known at that time, no houses were permitted to be erected for a distance of two to three miles outside the city walls, nor anything which could give shelter to an invading army, so that there was no question about suburbs outside the walls. These walls surround the city at the south side, where it has the shape of a half circle, while the diameter is at the north side, where the greatest navigable branch of the Rhine, called the Waal or Vaal, offers extensive and convenient landing places for the commercial fleet of steamers and very large sailing vessels which connect it westward with Rotterdam and the many flourishing smaller towns along the river, and southeastward with the cities of the Rhine, Dusseldorf, Cologne, Mainz, Frankfort, Strasburg, etc.

Fig. 1 represents a small portion of the water front, namely, that part where the tower of the large church is visible, which stands on the extreme western end of the series of hills on which the upper part of the city is built. This tower is at a much greater distance than appears on the picture, as there are several streets between and parallel to the water front and the hill on which the church stands, each street at a higher level than the preceding, until the difference in level becomes so great that the cross streets become too steep for ordinary pavement, but were paved with steps, which form a short road from the upper to the lower part of the city. The latter is built on the level plain, which extends from there to the ocean, for a distance of more than 100 miles, without a single hill.

FIG. 1.—VIEW OF THAT PART OF NYMEGEN WHICH CONTAINS THE LARGE CHURCH.

The lower part of the city is at the land side defended by earthworks in connection with deep ditches filled with water, but in the higher parts of the city, which are much larger than the lower, ditches with water are out of the question, and the defenses consisted in a most intricate network of batteries, bomb-proof casemates connected by tunnels, a multitude of subterranean passages leading to further outposts, etc., but none of all these works were armed with guns, which were stored inside the city in armories and magazines; and as no harm could befall these earthworks in times of profound peace, they were totally abandoned, and left to the good pleasure of the boys of the rising generation, who were never slow to make good use of them, and every Saturday Young Nymegen came out in full force, weather permitting, and had their games there in the dry ditches, climbing up embankments, leading imaginary battles, hiding themselves in the casemates, rolling down the hills, popping out from some subterranean passage, etc.

The good boys usually collected bouquets of wild flowers for their mothers and sisters at home, the locality being equivalent to a nursery for wild flowers, and also frequently visited by botanists, while trees did not interfere with the growth of the inferior vegetation.

The main wall of the city was inside of these earthworks, and consisted in a rampart of some 40 or 50 feet high, being stone or brick, nearly perpendicular and supported on the inside by an embankment of solid earth, some 40 feet wide on top and sloping down inwardly, being covered with grass on the sloping sides. On the top of the brick wall were parapets or breastworks of earth mounted by barbette guns, sentinels keeping guard. This was always the case at each of the six gates which gave admittance to the city, and which were exteriorly defended by the earthworks.

All the advantages here described and which the young generation in my boyhood experienced have been done away with, unfortunately for the boys of the present generation, but fortunately for the welfare of the whole people. The government, to whom all the land belonged, came at last to the conviction that the time had passed which made it advisable to reserve all this land for war purposes, especially in a country where land was scarce and the population large. All the batteries, etc., were leveled, laid out in streets and lots, and sold at public sale, after the American fashion. It was eagerly bought, the millionaires of Amsterdam and Rotterdam securing the choicest lots, commanding the finest views, while the most advantageous sites were reserved for public parks and boulevards.

Our second figure is a view down the principal street, taken from the site of the public parks in the highest part of the city toward the west, where the church is situated. From this street the cross streets descend, especially those at the right, which lead directly down to the river.

Our third figure represents the chapel built by Charlemagne, and which stands in the oldest of the public parks. It shows also the view down the river, whose peculiar ferry boat may be faintly seen; it crosses the river by the action of its current, being attached to a very long chain anchored above, and made to float by small boats, by which it is supported. At present a feat has been accomplished which in 1810 was considered impossible, even by the most eminent engineers of Europe, which were summoned there by the first Napoleon, namely, to build a bridge across that river. Their conclusion was based on the information that in winter the river becomes often obstructed by ice, which made the water rise 20 or 30 feet, inundating all the lower part of the city. The cause that the engineers of that time considered it impossible to build a reliable permanent bridge there was that then the use of steel for bridge building was unknown. Now there is not only a steel bridge there for railroad purposes also, but several steel bridges have been built over much wider rivers than that at Nymegen.

Our fourth figure represents the ruins of what some hold to have been a pagan temple, built by the Romans, while others hold it to be a Christian church, built at the first introduction of Christianity in the Grand Duchy of Gelderland, of which Nymegen was the capital, when it coined its own money, and held the surrounding lands under its dominion, which are still called "het Ryk van Nymegen," which means "the Dominion of Nymegen."

Both temples, Figs. 3 and 4, are situated in the oldest of the public parks and constitute some of its historical relics. These parks were established one century ago, when the other less antique buildings, which together formed the large castle on the hill, were demolished, being considered of no account, as they had come down from the middle ages, and been built only 600 years ago. Among them was a square tower, the counterpart of that now seen among the ruins of Heidelberg, Germany, which the French in one of their destructive invasions of the valley of the Rhine attempted to blow up with gunpowder, but only succeeded to crack it and make it deviate from its perpendicular position; so it stands now.

On the right side of Fig. 4 is seen in the distance the "Belvedere," so called. It was built 300 years ago by the Duke of Alva, on the highest point of the city walls, and was intended for a military watch tower, to keep the city and surroundings under control of the Spanish power, as from its top one may look down upon the whole city, notwithstanding its high situation. It is now a favorite place of refreshment, attractive by the extensive panorama it offers to visitors.

FIG. 2.—VIEW DOWN PRINCIPAL STREET, FROM THE PARKS TO THE PUBLIC SQUARE AND CHURCH TOWER.

FIG. 3.—OCTAGONAL CHAPEL, BUILT BY CHARLEMAGNE MORE THAN 1,000 YEARS AGO.

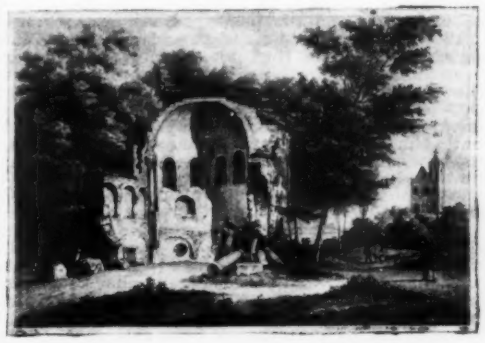


FIG. 4.—REMNANT OF A TEMPLE BUILT SO LONG AGO THAT THERE ARE NO RELIABLE RECORDS AS TO ITS AGE.

A THEORY OF ILLUMINATION.

"L. T. M.," in the *Scientific Press*, asserts that the development of the theory of light has made considerable progress of late years, and its true nature correctly defined; but, according to my views of the subject, scientists are still somewhat off the track as regards certain minor points, such as the illumination of opaque bodies.

A beautiful analogy exists between the phenomena of sound and light. It is universally understood that both are the results of the same great force—motion. Motion in the atmosphere and motion in that mysterious fluid, ether, appeals to our senses, the former to our ears, the latter to our eyes, producing the effects we call sound and light.

Now, ether is that subtile fluid filling all space, permeating all matter, the media of light waves whereby light and heat are transmitted from the sun to our earth. There is an intense agitation and commotion of particles continually going on in the sun, and these impulses transmitted to the surrounding ether are carried on and out in ever-lengthening lines until some of them strike our interfering atmosphere and we have the phenomenon of light.

Darkness, you say, is due to the absence of light, and light, we have just seen, is atomic vibration; hence darkness must be comparative passivity. Go to your room at night when all is dark and you see nothing

whatever, for the composing atoms of each object in that room are in comparative rest. But now light the gas; immediately vibration is set agoing by the combustion, and passing on it agitates the atoms of every object present.

You now look at matter made visible not by reflected rays, as commonly supposed, but by light waves of their own creation, caused by the imparted energy. A luminous body is the source of etheric light waves, while an opaque substance is made visible by the presence of a luminous one.

Light is as much more subtile than sound as ether is than air, and the general truths of the one apply to the other, and *vice-versa;* hence, in tracing the analogy we discover a beautiful correspondence between sympathetic *sound* vibration and light illumination, which we at once see is nothing more than sympathetic *light* vibration.

The rays of the sun reach the side of the moon visible to us, creating among the atoms of that body a violent agitation. When they strike, their office is fulfilled; their motion has been checked and they cease to be. But now the commotion of the moon's particles imparts its energy to the surrounding ether and thence to us, giving us the delightful evenings of full moon.

Give credit where credit is due, give the honors to the moon and stop heaping them upon her big brother the sun. She vibrates in sympathy with his vibration, the analogy here being perfect—stop the source of the sound, and there would be no sympathetic vibration from a neighboring instrument; refuse the moon the presence of the sun, and she would ever remain invisible.

In the particles of most matter composing opaque bodies sympathetic vibration ceases the moment the luminous one is removed, the atoms returning to their original comparative passivity. Some substances, however, are exceptions, such as the sulphides of calcium, strontium, etc., which retain, for a short time, the imparted energy. It is to these substances we attach the name phosphorescent.

This somewhat meager outline of light propagation may be profitably extended in all the various phenomena of light with interesting results. We are not yet at the end of the tether of discovery; many startling facts await our persevering efforts.

EXPLORATIONS AT COPAN, HONDURAS.*

By Mr. M. H. SAVILLE.

THE antiquities of Honduras have been placed under the care of the Peabody Museum, Harvard University, Cambridge, Mass, for ten years. The decree was issued in 1891, and the first expedition was sent out November last, reaching the ruins about the first of December.

When the expedition arrived at the ruins of Copan, they found the site of that ancient city covered with a dense tropical forest. This forest was first cleared, bringing to view the great plaza with the marvelous statues which have been so often figured, and that were first described by Stephens in his work, "Incidents of Travel in Central America." The ruins have been visited since that time by Mr. Maudslay, of England, who spent much time and money in photographing and moulding the sculptures of that place.

The object of the Peabody Museum expedition was to supplement Mr. Maudslay's work, and also to carry on excavations in the many ruined stone structures and in the tombs, of which there are very many to be found in Copan. During the winter many rooms were cleared and a number of tombs explored, which resulted in finding many skeletons and the objects which were placed in the tombs with them. In one of the mounds explored between thirty and forty skeletons were found, and an immense quantity of potsherds and broken obsidian implements. The main structure of Copan is one of the most marvelous and instructive in the new world. It was not understood by Stephens, who could see no evidence of any buildings upon it, and until last winter was covered with a primeval forest. During the winter one-third of the forest was cleared away, exposing the great river front which so excited the wonder and admiration of Stephens. This structure is of irregular shape, the length along the river front being about 780 ft., while the western side is about 560 ft., and the height at the highest point is about 120 ft. Among the famous mounds on this structure is one in the extreme northeastern part overhanging the river. It is on the upper level above the western and eastern courts. The steps on the side of the main structure lead up directly to this level, which runs along the top of the northern part of the structure, southerly to pyramid sixteen and separates the two courts. This mound was very much destroyed, and the general appearance was simply a mass of stones and earth on which large forest trees were growing.

Excavations were begun at the southwestern part of the mound. A building was discovered built against the western side of the mound on a terrace about 30 ft. long. The front wall of this building has fallen outward, and was originally 3 ft. in thickness. This building faced the south, and the doorway is 7 ft. in width; it has two chambers, running from east to west; the steps leading to the inner room are a little over 2 ft. in height, and the doorway is nearly 9 ft. in width. The stones composing these steps are laid in three courses, the upper course projecting about 3 in., and has a hieroglyphic inscription cut in it of sixteen letters. The first letter resembles the heading which is usually found at the beginning of inscriptions on the stellæ of Copan and Quiriquce, and also on the inscription of Palenque. The divisions of this inscription are unique, the characters being disks joined together near the lower part by a loop; they are placed, one after the first three letters, the next in the middle, and next three before the last three letters; below the center part of this inscription on the lower course of stone is a large square cut in the stone; on each side near the top is a small square at right angles with it, about one foot away; on each side is a disk cut out, the characters resembling those in the stone of the roof of the house of dwarfs in Uxmal, Yucatan. The roof stones show the first room to have been about 8 ft. in height, the rear chamber being only about 6 ft. high; the rear wall of the building is 5 ft. in thickness, and has fallen outward. The cement on the floor of the front chamber is rather broken, but that of chamber 2 is cracked and raised. This line of rupture runs from east to west, and continues through the western wall of the room to the eastern wall of the building adjoining. There is another long crack in the main structure, running from north to south parallel with the river front. The walls in nearly all the buildings explored in Copan have fallen outward, presenting a different appearance from those of the ruined edifices in Yucatan; while the buildings in Yucatan were probably destroyed by vegetation and perhaps by the hand of man, in Copan there is evidence of a stronger force, the earthquake, producing the long cracks seen in the main structure, breaking off several of the stellæ just above the base and wrenching others from their foundation. The main part of the mound was composed of five terraces, forming a rectangular structure. These terraces on the north side are destroyed, and on the eastern side have fallen into the river, but the western and southern sides are in a good state of preservation. They average a little over 4 ft. in height and are about 3 ft. wide. The two upper courses of stone project over in all of these terraces with the exception of the lower terrace, in which the three upper courses form a projecting coping. The cornice seems to have been literally battered down by the mass of debris falling from above. Against the southern side of the mound is a steep flight of steps made of small stones, which once led up to a low platform one foot in height, on the upper terrace. They are about nineteen in number; the roots of trees have done much to destroy the upper part of these massive steps, but the lower part are in an excellent state of preservation, and it seems very probable that the building which once stood above fell before any vegetation grew upon the structure. The building which once crowned this terrace is now almost completely demolished. Simply two parallel walls remain, running north and south, about 6 ft. high and 8 ft. apart. Between these walls a flight of steps once led up to some platform or room, which is now totally destroyed. From the mound of masonry which had fallen, it is highly probable that this edifice was about two stories in height, and perhaps was a tower elaborately ornamented. About ten feet east of the flight of steps is a terrace running southward between the lower terrace of mound twenty-one and mound twenty, which is immediately south, which was partially explored by Mr. Maudslay seven years ago, and supposed by him to have been the tower mentioned by Paloctio, who visited the place in 1576. This terrace is 4 ft. in height, with four steps leading up to it; 3 ft. east is the front wall of the building, with a doorway in the center opposite the steps. This building has fallen into the river, and only about 2 ft. of the room remains along the river front. This chamber extends from north to south and had a raised platform at each end. Through this terrace on a level with the floor, at the base of the steps, are two small passages about 10 in. in height, and the same in width; they are located one on each side of the steps, and the eastern ends appear on the river front, a little lower than the floor of the court, and a little larger than at the western ends. They were probably sewers for draining the space between the two mounds. Between this terrace and the steps of mound twenty-one is a small chamber built in front of the first terrace of the mound. The eastern wall of the room is built in front of the north canal, or sewer, and closes it up. The top of the roof of this chamber is only 4 ft. high, and it has two doorways 2 ft. in height, and about 2 ft. wide, over which are stone lintels. This chamber has the same wall of roof as the Yucatan buildings, and from the floor to capstone is 3 ft. 3 in. Over the roof of this chamber another small chamber had been built, but is now destroyed, the roof and walls having been crushed in by the falling of debris from the building above. This room was of about the same size as the room below. The buildings, terraces and steps were once covered with cement, but no traces of painting were discovered. Stucco, vases and other fragments of the same material were found at the base of the steps, showing that the use of stucco in the ornamentation of buildings was not unknown in Copan. Many beautiful sculptures, vases and ornaments were found in the debris at the base of the steps. No lintels were discovered in the debris of the doorways, and as they are too wide to have had lintels of stone, wood must have been used. In Yucatan, wooden lintels in a perfect state of preservation are still to be seen fallen, or in place in the buildings, but in all of our excavations in Copan we found in the wide doorways no traces of lintels.

Mahogany and cedar are to be found near Copan and the climate is fully as favorable for the preservation of wood here as in Yucatan, and the vegetation not quite as dense.

It seems very probable that many centuries have elapsed since the destruction of the buildings, during which period the wood has entirely disappeared.

* Read before the American Association for the Advancement of Science, Rochester meeting, August, 1892.

MINERALOGICAL EXHIBIT AT THE WORLD'S FAIR.*

By GEORGE F. KUNZ.

REALIZING the importance of securing the co-operation of all those interested in mining, metallurgy, geology, and mineralogy at the coming World's Fair, I suggested to the Chief of Mines and Mining, Mr. F. J. V. Skiff, that he be present at this meeting and give the members of this section a brief statement of the character of the exhibits, and some general idea of the list of exhibits already promised. Mr. Skiff, finding it impossible to attend, wished me to say a few words for him. As a simple reading of the classification and a list of the more important exhibits would require fully one hour's time, I will therefore give only the briefest outline of the scope and importance of the exhibits to be shown in the Mining building.

The building of mines and mining is entirely completed, and will be ready to receive exhibits even before the inaugural exercises in October next. The building is 700 ft. long and is 350 ft. wide. At an elevation of 25 ft. above the main floor, on both sides of the building, is a gallery 60 ft. wide, running the entire length of the building. Up to the present time there have applied for space in this building 26 foreign governments and 36 States, these exhibits to be supplemented by other State and government exhibits, such as that of Sweden, in the Swedish building; the East Indian, in the East Indian court; Illinois, in their State building, etc.

* Read at the Rochester meeting of the American Association for the Advancement of Science, August, 1892.

LIST OF STATES AND TERRITORIES MAKING OFFICIAL APPLICATION FOR SPACE IN THE MINING BUILDING.

For Collective Mineral Exhibits.

Pennsylvania,	Michigan,
Colorado,	Montana,
Ohio,	New York,
California,	Missouri,
Utah,	Minnesota,
Iowa,	Wisconsin,
Indiana,	Idaho,
New Jersey,	Maine,
Arizona Ter.,	West Virginia,
Virginia,	Kansas,
Maryland,	Kentucky,
New Mexico,	Massachusetts,
North Dakota,	Connecticut,
Washington,	Texas,
Wyoming,	Ind. Ter. (Oklahoma),
New Hampshire,	Arkansas,
North Carolina,	Florida.

LIST OF FOREIGN GOVERNMENTS MAKING OFFICIAL APPLICATION FOR SPACE IN THE MINING BUILDING.

Asia.

Japan.

Europe.

Germany,	Canada,
Austria,	Cape Colony,
Gt. Britain and Colonies,	France,
New South Wales,	Belgium,
	Spain.

South and Central America.

Nicaragua,	Costa Rica,
Guatemala,	Honduras,
Hayti,	Peru,
Venezuela,	Trinidad,
Colombia,	Ecuador,
Uruguay,	Argentine,
Bolivia,	Brazil,
Chile,	Mexico.

Starting with a scientific collection of all the known elements, and with them a complete collection of all the known alloys of gold, silver, copper, zinc, tin, etc., such as electrum, German silver, Babbitt metal, fusible metal, and the thousand and one other common and rare alloys, used in the arts and industries.

In the name of the Lake Superior copper mines, Professor Alex. Agassiz has promised a complete exposition of ores, rocks, and processes, illustrating the occurrence, mining, and metallurgy of copper.

There is now in preparation a coal collection, to contain all varieties of coal, from every known occurrence in the United States, as well as full series of rocks.

Petroleum and the subject of abrasives of all kinds will form a special exhibit under the charge of Mr. T. Dunkin Paret, who has devoted his entire life to this subject, and is now making a special European trip to enlist the co-operation of foreign manufacturers and investigators to supplement the American exhibit.

The De Beers Mining Company, of South Africa, who own and control more than ninety-five per cent. of the entire diamond output, will make a full and comprehensive exposition of diamond mining, and the original blue stuff, a decomposed perdotite inclosing carbonaceous shale, the matrix of the diamond in great quantities. When passing it through the various washing machines, sorting tables, showing every process separating the diamond from the matrix, in which exists a percentage of one carat, 205 milligrammes in a load of 1,600 pounds.

A case containing over 10,000 carats of diamonds of all colors and of the various qualities and with a full series of the associated minerals and rocks.

Every stage of the cutting and polishing of the diamond.

Nearly every mineral dealer in the United States has applied for space, and from the foreign trips and other preparations it is very evident that in the line of cabinet specimens and educational minerals the assembled collections will exceed those of any other exposition in importance.

One of the large gallery halls will contain a reference library for the use of visitors. This it is hoped will be a very comprehensive exposition of the literature of the subject of mines, mining, geology and mineralogy. This is to be supplemented by historical portraits, documents, and other allied material.

An early history of mining and mining processes will be shown, starting with stone hammers and other aboriginal implements found in the copper mines of Lake Superior and the turquois mines of New Mexico, the old Mexican pateo, to the most improved modern methods, and the remarkable sectional and glass models of mines, prepared by eminent mining engineers, used in the great mining lawsuits to prove their arguments.

One of the large corridor rooms in the gallery has been offered to the American Institute of Mining Engineers for their own use as a headquarters during the exposition. They in turn may extend the courtesy to mechanical and civil engineers, as well as the English, German, French and other foreign engineers whose hospitality they enjoyed in 1889; and there is every reason to believe that at least from 800 to 1,000 foreign engineers will visit the exposition. In addition, they will have a club room in Chicago. I believe that the proper committees from the various sections of the A. A. A. S. might receive similar hospitalities in other of the exposition buildings. The value and comfort of such quarters cannot be overestimated.

If only three-fourths of the promised exhibits are re-

ceived—and there is every assurance that there will be many more coming—it can be safely said, even at the present day, that the mining, metallurgical, geological and mineralogical exhibits of the Columbian World's Fair will exceed in scientific importance and in extent the combined exhibits of the Centennial, the 1878, 1889, the Paris and the Vienna expositions, at least twofold. For once, the enterprising coal, iron or other mining company will be limited by reason of granted space to three cubic feet for any single variety of coal or iron, and not by its financial capacity to pay freight on an ore or coal heap, which has unfortunately rendered the visiting of some of our former exhibitions so laborious and uninteresting.

A POET INVENTOR.

MR. THOMAS HILL, of Jersey City, N. J., is one of our most respected, ingenious, industrious and successful mechanicians. His name figures prominently in the galaxy of immortals whose inventions adorn the records of the Patent Office. He has secured many patents. Whenever you notice an iron-bodied sloping-ended dumping cart passing through the streets, you will recognize one of Mr. Hill's most useful inventions. It is to be seen in nearly all of our cities and has quite generally superseded the old-fashioned tail board cart.

It is not often that poetic genius and inventive talent are allied in the same intellect; but Mr. Hill is an exception. Although he is a self-made man, a great worker and practical inventor, the muse's soft influence will, at times, sweep like a summer's breeze through the Æolian chords of his mind, producing spontaneous melodies. Here is an example which he has kindly furnished us for publication:

THE INVENTOR.

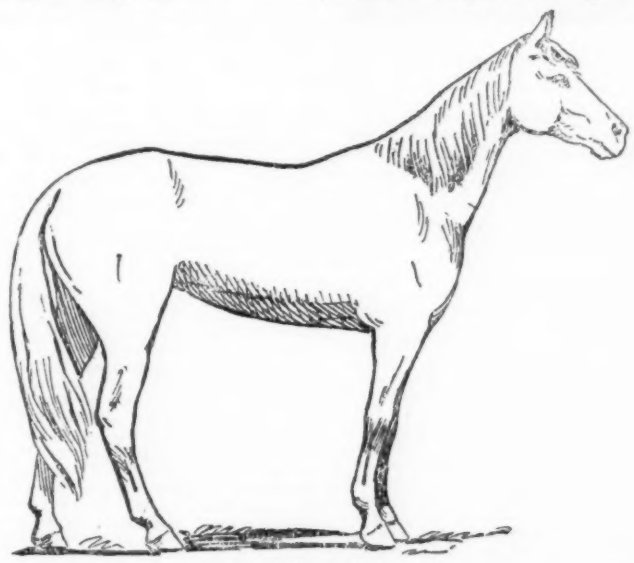
I wish not to invent, but what am I to do?
I can't prevent my thoughts, however I pursue.
Long time ago I thought I was adone,
Only to find that I had but just begun.
Can you advise me now, what course it's best to take,
To prevent my rising thoughts
From being put into shape?
For I must now confess,
It's far beyond my skill,
Unless by greater hardship,
To regulate my will.
First comes the thought of novelty,
Which everybody knows,
For the inventor's skill without this trait
Would only be to pose.
Simplicity, if it can be done,
With novelty combined,
With bold relief, it shows at once,
The strata of the mind.
Stability of construction next
Must now my thoughts imply;
For without this essential thought
My other thoughts must die.
With these foundation thoughts,
I to the work must go.
A patent I must have,
Whatever else may go.

THOMAS HILL

NANCY HANKS, THE FASTEST TROTTER.

THE fastest one mile trotting horse in the world, up to a recent date, was Maud S., owned by Robert Bonner. Time, 2 min. 8¼ sec. Then came Sunol, 2 min. 8½ sec. The time of these wonderful horses was eclipsed on the 17th of August last at Chicago by the mare Nancy Hanks. Time, 2 min. 7¼ sec. We are indebted to the *N. Y. World* for our sketches of this remarkable animal, also for the pneumatic sulky used on the occasion mentioned, and the following particulars.

Mr. Bonner is of the opinion that this new style of sulky, owing to its lightness and easy riding qualities, is what gave the victory to Nancy Hanks.



NANCY HANKS—2:07¼.

"There is less draught with the ball-bearing sulky," Mr. Bonner continued. "Some authorities place the decrease in draught at 50 per cent. In the old sulky, however light, there was a decided draught; the tire would cut in, no matter how hard the track was.

"The pneumatic tire is a great benefit to the driver as well as to the horse. The vibration in the old sulky was one of the drawbacks to increased lightness. In 1884 Maud S. used a 42-pound sulky, but I have heard old drivers say they preferred a 48 or 50 pound one, as it was firmer and trembled less. There seems to be some difference of opinion as to which is better, a 28-inch wheel or a 32-inch.

"There is one thing about the new tire which has impressed me greatly," added Mr. Bonner. "It seems that it enables bicyclists to turn corners with great ease, and it ought to perform a similar service for trotters. In my opinion it would bring the circular track up to the kite-shaped, which has had an advantage hitherto in that it had less corners. I think it will put the circular track back into favor again for speed."

The striking thing about the new sulky is the low wheels. In the old style vehicle the driver sat between them. Now he sits above them. The wheels average about 30 inches in height, about the same as a safety bicycle seen on the roads and tracks. It has ball-bearings wherever there is play for an axle. In the old sulky the wheel turned on a greased axle. Now, in the hub of the wheel is a row of balls about the size of buckshot and of the hardest steel. The axle is placed on these balls, which eliminate the old-time cone-bearing friction. The rim of the sulky is of wood and the spokes also. A road safety bicycle weighs from 35 to 45 pounds; a racer, about 20 pounds. A sulky with the pneumatic tire attachment gets down in weight to about 40 pounds, but many horsemen are applying to the bicycle dealers for regular bicycle wheels to be attached directly to the sulky. The tire, which is of rubber, is blown up with air, the same as in a bicycle. An inch and a quarter tire, or even larger, is left hollow and is pumped full of air by means of a small pump. The hole is then made air-tight and the tire will remain firm until the air leaks out through a puncture or faulty plugging. In the early days of the pneumatics the solid tire racers got revenge for less speed by sprinkling tacks over the course. They would puncture the rubber and thus in a few seconds leave the rider with a useless wheel.

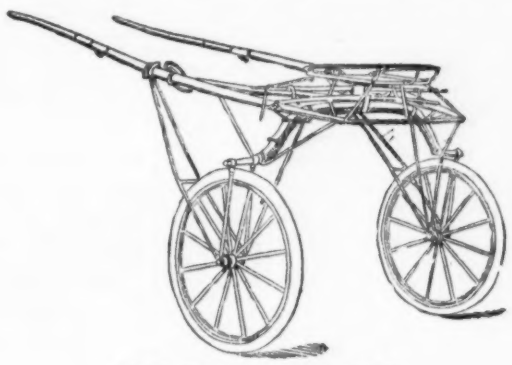
The sulky that did the best work on the grand circuit in the West recently had a wheel about 28 inches high. Though Mr. Bonner did not feel like passing upon the best size of wheel, Western horsemen consider that the low wheels do not give any advantage; rather that the ball bearings and tires enabled the 28-inch sulky to win in spite of the low wheels. They say that the long-accepted theories concerning high wheels cannot easily be disproved, and that it will not be long before horsemen will want sulkies having wheels of the usual height, but supplied with the frictionless bearings and pneumatic tire.

Nancy Hanks, the new queen of the trotting turf, like many of the trotting celebrities in the past, is a small-sized animal, not exceeding 15 hands in height. She is a dark bay, and a trifle angular in her general outline.

It has been stated by those who have examined her that Nancy is somewhat calf-hocked and has a peculiar habit of crossing her hind legs when walking. She is one of the most thoroughly honest, reliable trotters that has ever appeared upon the turf, however, and her career has been marked by such a succession of brilliant victories as has never fallen to the lot of any other trotter of her age. Nancy's first appearance in a public race was at Harrodsburg, Ky., July 31, 1889, where she met Bonny Wilmore, Abbey V., Twist, Catherine Leyburn, Minnie More and Mattie H. The first heat was won by Bonny Wilmore in 2:28¾, after which Nancy Hanks led at the wire in 2:27¼, 2:25¼, 2:25½. The above is the only heat that she has ever lost. She won in all seven races that year, and closed the season with a record of 2:24½.

In 1890 Nancy Hanks won six races, the most notable of which was at Lexington, Ky., August 28, where she defeated Bonny Wilmore and Mattie H. in 2:19½, 2:19½, 2:14½. The third heat is the fastest ever made by a four-year-old trotter in a race.

Last season Nancy fully maintained the great reputation for speed, pluck and endurance that she gained in her four-year-old form. She won at Pittsburg, Detroit, Buffalo and Chicago. August 27, 1891, she met the wonderful trotting stallion Allerton, at Independence, Ia., and defeated him, though the son of Jay Bird forced her to go the fastest race ever trotted. The time of the heats was 2:12, 2:12½, 2:12.



THE PNEUMATIC SULKY.

August 24, 1891, Nancy was started at Cambridge City, Ind., to beat her record. She was accompanied by a runner, the latter going to saddle. She trotted the mile in 2:09¼. The time by quarters was 0:32¼, 0:31¾, 0:32, 0:33¼. The runner, who was to encourage her, on the last quarter met with an accident, and she finished the mile alone.

Nancy Hanks is the property of Mr. J. Malcolm Forbes, the well known Boston yachtsman, who bought her at the reported price of $40,000.

THE ASCENT OF SAP IN PLANTS.

MOST individuals interested or actively engaged in scientific work will be able to recall occasions when it has been suggested to them that at the present rate of discovery there would soon be nothing left to find out, concerning objective phenomena at any rate. A comparison of the number of fresh facts and theories now annually published with the much smaller proportion that saw the light in an equal length of time a generation or two ago, coupled with the fallacious notion that finality in any degree is likely to be reached in matters scientific, may afford sufficient excuse to those who, not gifted with ability to see beneath the surface of things, confidently formulate such queries. Quite apart, too, from the fact that each addition to the world's stock of knowledge usually but opens the way to a number of fresh researches, the point is often overlooked, even by those better informed, that many problems of ancient date are yet but partially solved, if solved at all. Such a problem, familiar to all students in botany, and at times painfully impressed with all its difficulties upon the minds of examinees, is that relating to the ascent of water in plants. It is not until the question is put direct, "How does the sap rise?" that we are quite aware of our state of blank ignorance upon the subject. Text books explain the matter in more or less plausible ways, and doubtless it may be news to many to be told they know nothing about it.

The latest and perhaps the most thorough investigation in this direction is that by Professor Strasburger, of the University of Bonn. In the recently issued record of his latest physiological work the present aspect of the question is clearly put. It is shown that experiments in the "ringing" of plants had no other result than to again prove that the water current is conducted through the wood. The living alburnum in this alone is functional, but it is not admitted that living cells have any share in the process. Then, again, though facts seemed conclusively to indicate that the current passes through the cavities of the tracheæ, the theory that the protoplasm assists the passage of the water, by its contraction or by its influence on osmosis, had to be rejected as untenable. The evidence all appears to favor the conclusion that the ascent of water in plants is a purely physical process. That it is not a vital one was proved by the ability to cause an upward flow in plants previously killed by various methods. The conditions necessary for the ascent of liquid are stated to be that the cell walls should be in a state of imbibition, while the tracheæ are within certain limits filled with water and isolated from the air. The learned professor definitely disposes of some time-worn explanations when he states that atmospheric pressure simply helps to keep the water suspended, that the only importance of transpiration in this connection is that it makes room for the ascending fluid, and that root pressure is not immediately concerned in the process at all. Capillarity has long been known to be insufficient to account for the phenomena, and the net result of the research is that we are left in the position of knowing nothing whatever concerning the cause of the ascent of sap in plants, save that the process is a purely physical one.

This may appear but a poor result, yet it presents a very satisfactory aspect in that the way is thoroughly cleared for other investigators. Physicists may now take up the work, and unhampered by fictions posing as facts, or by baseless surmises euphemistically termed theories, carry it on with the hope of reaching a satisfactory explanation in a measurable space of time. It may be that Professor Strasburger himself is destined to reason out a fitting conclusion and so worthily crown his patiently and carefully built substructure of facts with an experiment-proof theory; but, be this as it may, it must be acknowledged that amid the mass

of valuable information contained in his new book, not the least useful contribution to botanical science in recent years is this seemingly negative research. It is well known that the reputation of this investigator has heretofore rested mainly upon his minute and exact acquaintance with the anatomical details of plants. As a result of this we find that the numerous convincing physiological experiments that have been performed are stamped with a special character, and once more bear out the exceptional value of a thorough and systematic training to those who would master nature's secrets.—*Pharmaceutical Jour.*

OBSERVATIONS ON THE SCENT OF FLOWERS.

IN the "Acta Horti Petropolitani," vol. xi., p. 383, Robert Regel gives an account of some observations made at St. Petersburg on the relation of the smell of flowers to external conditions. The relation is an evident one, but is not the same in different plants.

Plants whose flowers smell during the day have a much more intense odor in warm than in cold, dull weather; thus the mignonette and sweet pea have a much stronger smell on a hot clear day, and flowers of *Platanthera bifolia* grown in open places are more scented than when sheltered in woods. Flowers of *Reseda odorata* and *Philadelphus coronarius* which have already opened and contain ethereal oil smell strongly in the dark, and do not lose their smell in a dark room until they wither. To ascertain whether the ethereal oil can form in the dark, some pots of *Reseda odorata* and *Matthiola incana*, with quite odorless buds, were put in a dark room, while others in a light room had the inflorescence only cased in boxes covered inside with black paper and thus kept quite dark. The flowers of the second lot opened and smelt perceptibly, though less than when developed normally in a light room, but in the first case only those flowers smelt whose buds were well advanced when put in the dark; the rest had no smell, and no ethereal oil could be detected in sections of their leaves. Hence it is evident that in these two plants ethereal oil can be produced in the dark at the expense of some nutrient substance which, however, can itself only be developed in the light.

The flowers of *Nicotiana longiflora* smell much more at night than by day; they are open at night and in the morning and evening twilight, but closed by day. After a hot sunny summer's day the smell is more intense than after a dull cool day. When kept in darkness they no longer close by day, and smell both day and night. In specimens of which only the inflorescence was inclosed in dark boxes, all the flowers when opened gave a fairly strong smell; even when plants were placed entirely in a dark chamber, it was only in flowers that did not open till after three or four weeks that no smell could be recognized.

Nycterinia capensis behaved somewhat differently. Here also the flowers are closed and have no smell by day, opening only in the twilight and at night, when they are sweetly scented. The smell is probably due to the presence of benzolaldehyde (oil of bitter almonds) in the floral leaves, judging not only by the smell but also by chemical tests. After a warm sunny day the smell is stronger than after a dull cooler day. When placed in a dark chamber the plant behaves on the first day just as in a light room, smelling only by night, the flowers being closed by day and open at night. But if, in addition, the temperature be lowered, the result is different; thus, specimens placed during the day in the dark near an ice cellar, at one time at 8° R. and another at 11° R. (instead of the usual day temperature of 14°—20° R.), began to smell perceptibly after an hour, although the flowers were only half open, or even in some cases quite closed. To ascertain the influence of light on the formation of the odoriferous substance, the following experiment was made. Specimens with still odorless buds were placed in the dark chamber—in some cases plants in pots, in others cut-off twigs in water glasses. Other plants were placed in a light room and the parts of the inflorescence with odorless buds covered with dark boxes. The first flowers opening in these dark boxes smelt evidently, though fainter than normally, and it was only after two or three weeks, when the etiolated inflorescence had grown considerably in length, that no smell could be detected in the opening flowers; those opening earlier continued to smell till they withered.

In the case of plants kept wholly in the dark, the flowers which opened on the first day were scented, but not those opening later, and the former also gradually lost their scent. The single cut-off flowers, or inflorescences, in the water glasses lost their smell in the dark chamber after three to four days. In every case the complete disappearance of the smell coincided with the complete consumption of the starch in the cells of the floral leaves, only in the stomatal cells could starch grains be found, and it was possible to foretell with certainty which flowers would open and which would not, by investigating the starch content of buds in a sufficiently advanced stage of development; the strength of the smell also depended to a certain extent on the quantity of starch in the floral leaves. As a further illustration of this relation, cut-off shoots of the same Nycterinia were placed in the dark chamber —some in distilled water, some in half per cent. sugar solution. After about four days the former had used up their starch and ceased to smell, but the latter did not lose their starch, nor did the flowers cease to smell till completely withered. Even flowers which had already lost their smell in the dark regained it in sugar solution with the formation of starch in their leaves, while shoots taken from the solution and placed in distilled water in the dark lost their smell as soon as the starch disappeared. As the presence of starch is an index of the activity of constructive processes in the plant, the simultaneous disappearance of the smell of the flowers and the starch from the floral leaves of *Nycterinia capensis* shows that the formation of the odoriferous substance stands in the closest connection with the life of the plant.

In this point *Nycterinia capensis* differs from all other scented flowers investigated. In the floral leaves of *Matthiola incana*, *Rosa centifolia*, *Lathyrus odoratus*, *Dianthus plumarius*, *Reseda odorata* and others, either no deposit of starch was found, or only in the stomatal cells, while in the flowers of *Philadelphus coronarius* it occurred only in the stamens. The corolla of *Nicotiana longiflora* is rich in starch grains, but neither here nor in *Philadelphus* has their consumption the slightest influence on the smell of the flowers; in the latter plant flowers which already smell never entirely lose their scent when placed in the dark.

Experiments were also made on the relation between respiration and the scent in *Nycterinia capensis*. Shoots with the normal night-smelling flowers, when placed in an atmosphere of hydrogen, neither opened nor smelt; the effect was somewhat persistent, as the flowers when removed from the hydrogen did not open for some time, and even then did not smell. The next evening, however, they opened and smelt in the normal way.

Finally, the author points out that although normally only the open flowers of *Nycterinia* are odorous, yet the scent and the opening and closing are not absolutely dependent on each other, for the flowers do not usually begin to smell directly on opening, and we have also seen that under some circumstances, *e. g.*, in the dark, at a temperature lower than the normal, only half opened or even quite closed flowers may be scented.—*Natural Science.*

MONSTERA DELICIOSA.

A NOBLER plant than Monstera deliciosa, or Tornelia fragrans as some call it, we could not name, either for the stove, greenhouse, or the sub-tropical garden in summer. Apart from its stately aspect, it bears large succulent fruits possessing a luscious pine-apple flavor. In some gardens it is, like the banana, grown specially for its fruits, and is considered a choice addition to the dessert. Though the gigantic stature of this noble aroid, such as it assumes in its native habitat (the forests of Mexico), can only be seen in spacious hothouses, as for example in those at

MONSTERA DELICIOSA.

Kew, which are devoted exclusively to tropical aroids, still it may be grown to perfection in small houses, provided there are sufficient heat and moisture. It is never, however, seen to advantage unless it is so placed that the roots have free access to water in a similar manner to that suggested by the annexed engraving, which represents a fully developed specimen bearing fruits. It delights in places where it can cling to a moist wall or twine its pliant branches round the stem of a tree for support, and where also its thong-like roots can dip and ramify in a water tank, which is usually placed in all houses devoted to tropical plants.

When grown in these hot, moist stoves it develops rapidly, and its singular, perforated foliage, together with the quaint forms which it often assumes, strikes the uninitiated with wonder, and when studded with its cone-like fruits, it certainly presents a highly ornamental appearance. A high temperature and dense shade are, however, by no means necessary for its welfare; it enjoys a light, somewhat airy position, and when so placed it assumes a more shrubby, compact, short-jointed habit. It should always find a place in sub-tropical arrangements, as it does well in sheltered nooks or similar situations throughout the summer. Although the Monstera will thrive in a low temperature, it will not develop its true character as a fruit-bearing plant unless a brisk growing heat be maintained during the spring and early summer months. The elements of success in order to obtain fruit are heat, light, and moisture, and provided these conditions be one and all supplied, success will be insured. Any form of training may be adopted which will bring the plant well up toward the glass. It may be made to cover a portion or the whole of the back wall trellis, or, what is preferable, it may be trained round forked tree stumps, a system which suits it admirably. It may be grown in a tub, but preference should be given to planting it out in a good body of fibrous peat and loam in equal proportions, and which should rest upon a good drainage of brick rubble. Thus placed unlimited supplies of water may be given in hot weather, and the fruit will be fine in quality and abundant. The engraving represents the Monstera growing against a house at Funchal, Madeira.—*The Garden.*

[Continued from SUPPLEMENT, No. 867, page 13853.]

ON PEROXIDE OF HYDROGEN: A PHYSICAL MEDICAL RESEARCH.*

By BENJAMIN WARD RICHARDSON, M.D., F.R.S.

PART IV.—PHARMACOLOGICAL AND PRACTICAL.

IN this fourth and concluding part on peroxide of hydrogen I have to treat on the pharmacological and practical details of my subject, so as to enable the practitioner of medicine to see at a glance the nature of this medicinal substance and the manner in which it is best to prescribe it in disease. For a few pages the reader will be invited to dwell on matters of theory and practice relating to the manufacture of the fluid itself. Afterward he will be presented with a series of formulæ, the outcome of long experience, for the proper administration of it in the various details of practical medical work.

The Production of the Peroxide.

The theory originally advanced by Thenard has been ably condensed by Gmelin in the following passage: "When peroxide of potassium, sodium, barium, strontian, or calcium is digested in any hydrated acid, which forms a soluble salt with the salefiable base resulting from the decomposition of the peroxide, the excess of oxygen does not escape as gas, but passes over to a portion of the water, and *converts it into peroxide of hydrogen.*"

By what line of experiment Thenard arrived at this curious chemical fact there is, I believe, no record; it must have been the result of long experiment, the details of which have not survived, although they indicate an advanced chemical knowledge. By common agreement the peroxide of barium, baryta, seems to have been the substance selected as best for the process of manufacture of the hydrogen peroxide, and it continues to hold its own. The baryta must be freed from all foreign matter, especially manganese, must not give out heat on being made into a paste with water, and must be entirely soluble in dilute hydrochloric acid. When pure, it is a hard substance, presenting a grayish surface free of green specks. It can be kept for any length of time in a closed bottle.

The next step of the process, after Thenard, is to take a certain measure of distilled water, *twenty fluid ounces*, and add to that quantity *two fluid drachms and twenty minims* of pure hydrochloric acid. The acid must be mixed well with the water by agitation with a glass rod. Then *two drachms and ten grains* by weight of the pure peroxide of barium, reduced to a fine powder, is to be placed in a porcelain glass or enameled basin, and treated with a little water, until it is made into a soft paste. Next, with a glass or box-wood knife—an iron one must never be used for the purpose—the paste is to be gradually added to the acid solution until all is dissolved, but if there remain a precipitate, a little more acid must be dropped in to take it up. The first step of the process is now completed; the peroxide of barium has been transformed into the soluble chloride of barium, and at the same time the water has been charged with *one volume* of hydrogen peroxide.

To charge further it is necessary to remove the soluble barium chloride, which is diffused through the water. This is done by adding to the solution, very gradually, *one fluid drachm and a half* of dilute sulphuric acid, made by mixing *one* part of the acid with *three* of water. On this the baryta is precipitated in the form of insoluble sulphate, and there is left above a solution of *one volume* of peroxide of hydrogen, with the hydrochloric acid free and ready again for action. The solution must be poured off, the precipitate filtered through Swedish filtering paper, and treated with barium peroxide as before, and so the process is to be repeated until the charge of ten volumes of oxygen is obtained, or until the water is charged with oxygen to the amount required.

If over ten volumes be wanted, the stronger charge can be got by gentle evaporation of the water, and by this plan as many as *thirty volumes* of oxygen can be obtained; but here for practical purposes we must stop. Thenard, by evaporation and exhaustion with the air pump and sulphuric acid, obtained absolute peroxide, which charged the bell jar in a state of vapor, and yielded 475 volumes of oxygen. I spent much time, expense, and trouble in attempting to do the same, with the object of ascertaining if the peroxide of hydrogen in the gaseous form would support life as oxygen does, but I never succeeded.

If it be desired now to remove the hydrochloric acid from the solution, so as to have at hand the solution of peroxide of hydrogen pure and simple, sulphate of silver is added to the solution gradually, upon which chloride of silver is precipitated, and the solution containing sulphuric acid is left. This solution is decanted, filtered, and treated with baryta until all the sulphuric acid is fixed and thrown down as sulphate, and the solution is neutral to test paper. The solution once more decanted and filtered is the pure solution of the strength of volume wished for.

It is right to explain the manner in which the peroxide may be obtained in the pure state, but for pharmacological purposes it is rarely necessary to remove the hydrochloric acid. It is an advantage to allow the acid to remain, because its presence renders the oxygen more stable in the solution. The small amount of acid present is not injurious, and when it is necessary to have a neutral or alkaline solution, the gradual addition of a little pure ammonia, caustic soda, or potassa up to neutrality, is sufficient.

Simpler methods of making the peroxide have been employed. Pelouze suggested its manufacture by adding peroxide of barium to a solution of hydrated hydrofluoric acid. Fluoride of barium is thrown down, and solution of peroxide of hydrogen is formed. This has been called the "direct method," and I believe that for some commercial purposes it is rather largely employed.

* Continued from a research commenced in the year 1856.—*From the Asclepiad.*

Physical Properties of the Peroxide.

The properties of the peroxide of hydrogen as it exists in solution are peculiar. Some of them have been touched on incidentally in previous papers, but it will not be out of place to notice them here. The oxygen imparts no color to the solution, but gives a distinct odor resembling that from a weak solution of chlorine, and when a little of the solution is placed on the hands this odor is most marked. To the taste the solution, even in weak solutions, is caustic and styptic, and very strong solutions of it placed on the tongue cause pain. In the strongest solution I ever succeeded in producing a few minims of the solution placed on my lower lip turned the mucous membrane white, as if it had been frozen, and the return to the natural color was attended by a rather sharp tingling sensation.

In its highest concentration the peroxide of hydrogen has a specific gravity of 1·452, and at 30° Fahr. it does not freeze. It mixes with water in all proportions, and may be kept in solution at all ordinary temperatures. It is best, however, to store it in a cool place, and it is essential to see that the bottle containing it is at all times firmly closed. If the stopper or cork be left out, particles of dust may get into the solution and set the oxygen free. On the whole it is best to close the bottle with a good fitting cork, for although in time the cork bleaches and softens from contact with the solution, and even from the vapor of the solution, it retains the oxygen as securely as a glass stopper, and is easier to remove.

The action of light on the solution is negative; but heat causes the oxygen to be evolved. When the solution is heated to boiling point, the extra measure of oxygen does not go off until the boiling point is reached. Then the oxygen begins to evolve with the vapor of the water, and continues to go off until it is all gone, even though the water be made suddenly cool. But although heat of itself does not liberate the oxygen until boiling point is reached, it aids greatly the oxidation of various oxidizable bodies in contact with the solution, a point of considerable importance in the application of the solution for therapeutical purposes.

The electrical current passed through a solution of the peroxide of hydrogen causes decomposition in the usual way, the oxygen and the hydrogen appearing at their respective poles; but the oxygen is in larger proportion than if water simply were undergoing decomposition.

The grand peculiarity of peroxide solution is the readiness with which, under some circumstances, oxygen is evolved. This peculiarity has led me to doubt whether the solution be a peroxide of hydrogen at all and whether we ought not to consider it as oxygen combined with water as a radical, or with the oxygen of the water. To my mind it is ozonic oxygen in combination with water. It gives all the reactions of ozone while it is in combination, said reaction extending to water in finest division as spray. But when it is passing over with water vapor at a high temperature it loses its magnetic or ozonic qualities, and when it is liberated from the solution by other means and is caught in a bell jar for examination it also loses these qualities and acts like common oxygen. This might be expected from ozone combined with water.

It would be imagined that with oxygen in excess in a watery solution all oxidizable substances placed in the solution would be immediately and rapidly oxidized. Of some substances this is true. If to the solution sulphurous acid be added, that acid is more quickly oxidized into sulphuric acid; if to the solution arsenious acid be added, that acid is converted into arsenic.

There is nothing remarkable in the changes here named. But very remarkable is the behavior of some other chemical substances. If to the solution peroxide of manganese be added, the oxygen is liberated with the briskest action; if black oxide of platinum be added, the effect is still more striking; and the same is evidenced with the oxides of gold, silver and mercury.

Other bodies, themselves rich in oxygen, give up their oxygen on coming into contact with the peroxide solution. This is specially notable in the case of the permanganates. Add to a solution of peroxide of hydrogen a solution of permanganate of potassa, and the action is almost explosive. The red color of the permanganate disappears, and oxygen derived from both solutions can be collected in large quantity. I have availed myself of a knowledge of this fact in utilizing the peroxide for medical purposes.

A number of curious facts came out of my earliest experiments, indicating that the evolution of oxygen by the presence of manganese and substances similar in action could be more or less checked by the interposition of other chemical substances. Ammonia, I found, had this effect, hydrocyanic acid, alcohol, and a large number of the alkaloids capable of entering into solution with water, as morphia, aconitina, and strychnine. Some volatile bodies—ammonia, for example—have this power while they are in solution, but when volatilized the effect ceases.

Internal Administration of the Peroxide.

After I had succeeded in making the first quantity of the peroxide of hydrogen on Thenard's method, and had obtained a purely neutral solution which yielded ten volumes of oxygen gas, I proceeded to experiment with it physiologically and therapeutically. In commencing the therapeutical part, it was the first duty to determine the dose and the most agreeable means of prescribing the substance medicinally. I began by making a few experiments on myself. I put one fluid drachm of a *ten volume* solution into one ounce of ordinary water, and slowly swallowed the dose. The taste was peculiar, seeming to me metallic in character, but afterward it suggested itself to me that it was rather like chlorine water, and on tasting a solution of chlorine this view was confirmed. I also found that when I drew ozonized oxygen freely into the mouth, with a little water in the mouth, a similar taste was produced. The taste was styptic and metallic; it affected the posterior palate and fauces rather than the tongue, and the epiglottis was slightly irritated. The effects soon passed off.

The general effect of the fluid drachm dose not being very significant, I took on the next day *two* fluid drachms in *two* fluid ounces of water. The local effects were intensified considerably, and lasted for a longer time. A day later I took *three* fluid drachms in *three* fluid ounces of water, and a day later still *four* fluid drachms in *four* fluid ounces of water, with an additional ten ounces of water soon afterward, the local effects being disagreeable and the stomach becoming oppressed, as from distention. This condition lasted for a few minutes, and was succeeded by a slight exhilaration, with some quickening of the pulse and an increased flow of saliva, accompanied by a peculiar taste like that which occurs under potassium iodide. These results led me to propose a ten volume solution—since generally accepted—for medical purposes, and *one* to *four* fluid drachms, with water in the proportion of an ounce of water to a drachm of the solution, for the ordinary dose.

On the whole I have held to the ten volume solution as the most practical. It is more stable than the solution of greater volume; it fits in well in prescribing for internal use, and for solutions for external use—gargles, lotions, and injections—it meets, generally, every purpose. Moreover, it gives a uniform or standard solution, which is a great advantage; and I recommend members of the profession, when they order the peroxide, to mark this strength by adding the words "ten volumes" to the prescription.

One fluid drachm to four of the ten volume solution is the dose for adolescents and adults. For children under fifteen the dose runs from thirty minims to two drachms, diluted with an agreeable quantity of water.

The solution can be combined with simple sirup, with sirup of tolu, and with some emollient drinks, notably with barley water, a menstruum in common use with me for this purpose. But the most convenient sweetening menstruum is glycerine in combination with water. One drachm of glycerine to four drachms of the solution and the proper amount of water is the proportion I most commonly prescribe; but in phthisical cases I often increase the dose of glycerine up to two and three drachms.

The solution must always be kept slightly acidified with hydrochloric, sulphuric, or phosphoric acid; but when prescribed in this form the presence of the acid must always be remembered. Sometimes the acid may be retained with advantage; sometimes it may, with advantage, be neutralized by the addition of solution of soda, potassa, or ammonia; but in such neutralization the carbonates of these bases must not be used, since the escape of carbonic acid causes liberation of the oxygen.

Some Useful Formulæ for Internal Administration.

I will now add a few useful formulæ for the service of those who are not familiar with the solution in the prescription. The dose ordered is the full medium for adults:

Astringent and Oxygen Mixture.—℞. Solut. Hydrogenii Peroxydi (10 vols.), ʒ ijs.; Acidi Sulphurici Diluti, ʒ js.; Glycerini Puri, ʒ js.: Aquæ Destillatæ ad ʒ vj. Misce. Fiat Mistura. Dosis, pars sexta, modo præscripto.

This forms an excellent mixture in cases where the peroxide is combined with an astringent, as in cases of colliquative sweating in phthisis pulmonalis. Each dose of mixture should be diluted with six or eight ounces of water or barley water.

Mixture of Quinine and Oxygen.—℞. Solut. Hydrogenii Peroxydi (10 vols.), ʒ ijs.; Quinæ Disulphatis, gra. vj.; Acidi Hydrochlorici Diluti, ♏ xx.; Glycerini Puri, ʒ js.; Aquæ Destillatæ ad ʒ vj. Misce. Fiat Mistura. Dosis, pars sexta, modo præscripto.

A good mixture in cases where it is desired to combine quinine with oxygen, as in influenza and in febrile remittents. The quinine can be increased up to five grains per dose if necessary, and dilute sulphuric acid can take the place of the hydrochloric if the prescriber wishes. Each dose should be diluted in six ounces of water, cold or iced.

Mixture of Tannin and Oxygen.—℞. Solut. Hydrogenii Peroxydi (10 vols.), ʒ ijs.: Tannin, ʒ js.; Glycerini Purini, ʒ vj.; Aquæ Destillatæ ad ʒ vj. Misce. Fiat Mistura. Dosis, pars sexta, modo præscripto.

A very useful prescription in hemoptysis and in other instances in which there is escape of blood. If required, diluted sulphuric acid can be added in proper proportions. Each dose should be diluted with water, cold or iced, before administration, and the mixture should be kept in a cold place, since it has a tendency to undergo decomposition.

Mixture of Morphine and Oxygen.—℞. Solut. Hydrogenii Peroxydi (10 vols.), ʒ ijs.; Liquor. Morphiæ Hydrochlor., ʒ j.; Syrupi Tolutani, ʒ vj.; Glycerini Puri, ʒ ijs.; Aquæ Destillatæ ad ʒ vj. Misce. Fiat Mistura. Dosis, pars sexta, modo præscripto.

The morphine and oxygen mixture is of much value in cases of severe cough with expectoration, and with sleeplessness in consequence of cough, as in chronic and asthenic bronchitis, and in phthisis. The dose of morphia can be increased to any required amount, and mineral acid can be added if an astringent be desired. The administration should be by dilution in cold or iced water, as before.

Mixture of Codeine and Oxygen.—℞. Solut. Hydrogenii Peroxydi (10 vols.), ʒ ijs.; Syrupi Codeinæ, ʒ ij.; Sp. Vini Rect., ʒ vj.; Glycerini Puri, ʒ vj.; Aquæ Destillatæ ad ʒ vj. Misce. Fiat Mistura. Dosis, pars sexta, modo præscripto.

This form, for diabetes, has been already reported upon (*Asclepiad*, No. XXX.); but glycerine is here introduced as a good addition. The amount of sirup of codeine can be increased if necessary.

Mixture of Phosphate of Iron and Oxygen.—℞. Solut. Hydrogenii Peroxydi (10 vols.), ʒ ijs.; Acidi Phorphorici Diluti, ʒ j.; Syrupi Ferri Superphosphatis, ʒ vj.; Glycerini Puri, ʒ j.; Aquæ Destillatæ ad ʒ vj. Misce. Fiat Mistura. Dosis, pars sexta, modo præscripto.

The best combination I know of for asthenic cases in which iron, phosphates and oxygen are indicated. I have prescribed the mixture during the early stages of phthisis pulmonalis with special advantage. When the circulation is rapid and feeble, five to ten minims of tincture of digitalis may be added to each dose. The mixture is serviceable also in the anæmia of strumous subjects.

Mixture of Iron, Quinine and Oxygen.—℞. Solut. Hydrogenii Peroxydi (10 vols.), ʒ ijs.; Acidi Phosphorici Diluti, ʒ j.; Quinæ Disulph., gra., vj.; Syrup Ferri Superphosphatis, ʒ vj.; Glycerini Puri, ʒ j.; Aquæ Destillatæ, ʒ vj. Misce. Fiat Mistura. Dosis, pars sexta, modo præscripto.

The above form is serviceable in cases where quinine and iron with oxygen are likely to be suitable. If a sedative be called for at the same time, a proper dose of solution of hydrochlorate of morphia—five to ten minims—is admissible and compatible.

Mixture of Quinine, Iron, Strychnine and Oxygen.—℞. Solut. Hydrogenii Peroxydi (10 vols.), ʒ ijs.; Acid Phosphorici Diluti, ʒ j.; Syrupi Ferri Superphosphatis, ʒ vj.; Quinæ Disulphatis, gra. vj.; Sp. Vini Rect., ʒ vj.; Liq. Strychniæ, ♏ xxiv.; Glycerini Puri, ʒ j.; Aquæ Destillatæ ad ʒ vj. Misce. Fiat Mistura. Dosis, pars sexta, modo præscripto.

This mixture is of service in affections where Easton's sirup is useful, and where the addition of oxygen promises well. In anæmic conditions the addition of the oxygen is of considerable benefit. I originally prescribed the peroxide with Easton's sirup direct, but the combination was not satisfactory; hence the new form here prescribed. The action of the strychnine is somewhat increased in this mixture, and requires, therefore, to be carefully watched. The dose may be taken twice daily in six or eight ounces of water.

Mixture of Alcohol and Oxygen.—℞. Solut. Hydrogenii Peroxydi (10 vols.), ʒ ijs.; Spiritus Vini Rectificati, ʒ iij.; Glycerini Puri, ʒ vj.; Aquæ Destillatæ ad ʒ vj. Misce. Fiat Mistura. Dosis, pars sexta, modo præscripto.

The peroxide solution mixes readily with alcohol, and the above combination supplies a mixture of great value in cases where an anti-spasmodic is required in combination with oxygen, as in asthma and in some stages of collapse, where the breathing is oppressed. This mixture, moreover, may be accepted as a spirituous solution of peroxide, and may become the menstruum for other substances that are soluble in alcohol and do not readily undergo decomposition in the presence of oxygen. The mixture must be administered in water in the same proportions as already directed, and the water may be warm, cool, or cold (iced), according to the judgment of the practitioner.

This mixture may also be given with barley water or thin jelly, or with coffee. I have seen benefit of marked kind from it in asthma, angina pectoris, colic, and cramp of the lower extremities.

Mixture of Alcohol and Amyl Nitrite with Oxygen.—℞. Solut. Hydrogenii Peroxydi (10 vols.), ʒ ijs.; Spiritus Vini Rectificat., ʒ iij.; Glycerini Puri, ʒ vj.; Amyl Nitritis Puræ, ♏ xx.; Aquæ Destillatæ ad ʒ vj. Misce. Fiat Mistura. Dosis, pars sexta, modo præscripto.

The properties of this mixture are similar to those of the last, but the presence of the *amyl nitrite* renders it more decidedly antispasmodic in its action. The dose may be administered in six or eight ounces of water, but the water should always be cold, and the dose should be sipped slowly, never swallowed with a gulp, according to the common practice of swallowing medicinal substances.

N. B.—It is advisable to prescribe this mixture in limited quantities, say of six doses at a time, and not more, as the nitrite is disposed to undergo decomposition if it be retained long in the presence of the oxygen.

The combinations of alcohol with oxygen solution go well with ether, and produce a good antispasmodic compound, but I usually prefer, in prescribing the solution with ether, to use *ozonic ether*.

Ozonic ether, to which I have more than once alluded, is the peroxide in ether. I lighted upon it very early in my researches on shaking up a strong peroxide solution with anhydrous ether. It is made by admixing a thirty-volume solution of the peroxide with anhydrous ether, adding at the same time 5 per cent. of alcohol. It is a fairly stable compound. It can be administered in water in doses of half a drachm to two drachms, and can also be administered locally in the form of spray.

Ozonic Ether Mixture.—℞. Ætheris Ozonici; Spiritus Vini Rectificati, Glycerini Puri, ää ʒ vj.; Aquæ Destillatæ ad ʒ vj. Misce. Fiat Mistura. Dosis, pars sexta, modo præscripto.

In spasmodic breathing, as in pertussis and spasmodic asthma, this mixture is of much value. It is compatible to add to the mixture solution of ammonia (*fortior*) in two to five minim doses if necessary. In the case of children suffering from pertussis, I usually dispense with the alcohol and prescribe as follows:

Simple Mixture of Ozonic Ether.—℞. Ætheris Ozonici, ʒ iij.; Sirupi Tolutani, ʒ vj.; Glycerini Puri, ʒ iv.; Aquæ Destillatæ ad ʒ vj. Misce. Fiat Mistura. Dosis, pars sexta, modo præscripto.

There is, I believe, no remedy more effective in pertussis than this mixture. It should be administered in ice-cold water.

Mixture of Alcohol, Creosote, and Oxygen.—℞. Solut. Hydrogenii Peroxydi (10 vols.), ʒ ijs.; Spiritus Vini Rectificati, ʒ iij.; Ol. Creosoti, ♏ vj.; Glycerini Puri, ʒ vj.; Aquæ Destillatæ ad ʒ vj. Misce. Fiat Mistura. Dosis, pars sexta, modo præscripto.

This mixture is antiseptic, deodorant, and antispasmodic. I have prescribed it with best results in cases of irritable stomach, attended with sour eructations and vomiting of fermenting matter. In one instance of this kind in which malignant disease of the stomach had been diagnosed, recovery took place in fifteen days, as if some process of fermentation of a putrefactive kind had been stopped. The medicine was administered in iced water three times a day, with intervening light meals of peptonized milk, minced fowl, also peptonized, and distilled ice-cold water, bread and other amylaceous substances being forbidden.

Peroxide Mixture for Salivation.—℞. Solut. Hydrogenii Peroxydi (10 vols.), ʒ iijs.; Liq. Potassæ, ♏ xxx.; Glycerini Puri, ʒ vj.; Aquæ Destillatæ ad ʒ vj. Misce. Fiat Mistura. Dosis, pars sexta, modo præscripto.

The mixture can be administered freely diluted with water three times a day, and the quantity of the peroxide can be increased, if necessary, until the effect is produced. The patient becomes conscious of the salivation by the circumstance of detecting, as under iodine or mercury, a metallic taste, and of retaining the taste for a considerable period after each dose. He may also experience a sense of restriction in the pharynx, with over-secretion there. The increase of saliva is not so profuse as in salivation from mercury, and the gums are not inflamed; but I have seen occasionally a rather profuse flow of saliva, lasting for some days. On withdrawing the medicine the local effects soon cease. It is best practice to withdraw it by degrees, so as to keep up the effect of elimination for a week or

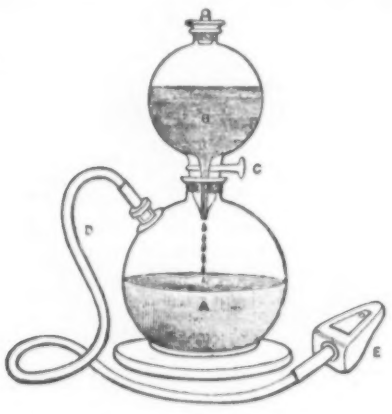
even ten days. The action is so like that of mercury, it is sometimes difficult to see the difference except in the absence of swollen gums and the more rapid subsidence of salivation on withdrawal of the medicine. The salivary glands may be rendered tender, on which the dose should be reduced.

The use of the peroxide for elimination up to salivation is best described as applicable to the class of case in which mercury or iodine would be employed. It is a substitute for these remedies, but it may be used in conjunction with them, to sustain or to quicken their influence. It does both, and renders small doses either of iodide of potassium or of Plummer's pill more effective than larger doses of them taken alone—an important advantage.

In prescribing the iodide or mercury with the peroxide, they (the iodide or mercury) should be taken at different times. I usually prescribe the Plummer's pill at night, and the peroxide solution three times during the day, when the peroxide is not effective enough of itself, and when the symptoms are very persistent.

Administration by Inhalation.

The oxygen from the peroxide can be administered by inhalation by means of the simple apparatus depicted below, which I have constructed for general use, and in working which I have taken advantage of another oxygenated body, that liberates the oxygen and at the same time yields up its own oxygen. The large glass vessel, A, is for holding the solution of the



peroxide. A tube having a stop cock, C, runs through the stopper of the vessel from a smaller glass vessel above, B, for containing the liberating solution. From the larger bottle, there springs tube, D, at the free end of which is a double-valved mouthpiece, E—shaped like the oldest and best of the chloroform inhalers—for inhalation. When the apparatus is wanted for use, a little less than half the lower vessel, A, is charged with the peroxide solution, and the upper one, B, is filled with the displacing solution, which consists of a saturated solution of permanganate of potassa. The tap of the stop cock is then turned, the permanganate solution drops into the peroxide solution, rendered of acid reaction by a little dilute hydrochloric acid, and immediately oxygen is briskly evolved. This, if necessary, can be caught in a flexible balloon or bag, from which it can be inhaled in measured doses, but it is quite as well to inhale it directly, and to regulate the supply by the mode in which the permanganate solution is admitted into the lower vessel. The solutions neutralize each other, and while there is no color in the lower solution, oxygen is being evolved. When color is shown, more of the peroxide is required to be admitted.

Should the practitioner desire to combine the oxygen with ether, or with any other volatile body soluble in ether, but not in water, he can pour the ether on the top of the peroxide solution in vessel, A. Then, as the oxygen escapes, the ether, or the ether with its other volatile comrade, passes over, in combination with the oxygen. Nitrite of amyl can be inhaled in this manner with ether; and, in short, there is here a means of administering most of the active volatile medicaments by inhalation, and in a form most ready for combination with the blood as it passes in its course over the pulmonic circuit.

The oxygen in passing through the ether reassumes ozonic properties, and the continued taste of the ether informs the patient that the action is being continued. A patient can help himself to a dose at any time as may be directed.

This mode of administration of the oxygen from the peroxide and permanganate solutions is of all others the most refined and effective. It is like a new instrument of treatment in phthisis pulmonalis, in asthma, in angina, in asthenic bronchitis, and other allied conditions in which oxygen combined with a sedative is called for. It was from this apparatus the patient suffering from pleural abscess described in last *Asclepiad* inhaled with such rapid benefit the *ethereal ozone*, as I would designate it.

Anæsthesia from Ethereal Ozone.

By increasing the surface of ether in the apparatus depicted above and forcing it over by the oxygen liberated with permanganate, sufficient ether can be diffused with the oxygen to produce general anæsthesia by inhalation. In administering the ether in this manner, it is not necessary to remove the mouthpiece from the face of the patient; he is receiving a supply of oxygen and ether that can be regulated in amount by the supply of the permanganate solution. Ten ounces of the peroxide solution of twenty volume strength are sufficient, with the additional oxygen from the manganese, to diffuse steadily into the mouthpiece from one to two ounces of anhydrous ether for inhalation. I am prepared to see this mode of administration of ether and of analogous anæsthetics become of general application. Such anæsthetics must be capable of floating on water, as well as insoluble. Chloroform and methylene sink to the bottom and diffuse too slowly.

Administration in Form of Spray.

Spray for the Sick Room.—Reference was made in a previous paper to ozonic or sea spray for the sick room. It is a solution diffused as spray from a spray producer. The solution is composed as follows:

Solution of Peroxide of Hydrogen (10-volume strength), 10 ounces; common salt, 2 drachms; Tincture of Iodine, 1 fluid drachm. To make a solution for spray.

If a pleasant and pine tree odor be desired, a few grains of kaurie gum can be added, and the effect can easily be produced. In sick rooms and in the wards of hospitals such sprays can be arranged to work automatically so as to deliver and diffuse the solution at regular intervals. For this purpose Messrs Krohne & Sesemann have constructed for me an apparatus which will distribute spray for several hours at a time.

For a styptic and deodorant spray for the throat the following form is useful:

Rectified spirit, 1 fluid ounce; Tannin, pure, 20 grains; Distilled water, 1 fluid ounce. Dissolve the Tannin in the alcohol and water, and add Solution of Peroxide of Hydrogen (10-volume strength) to make 6 fluid ounces. To make a solution for spray.

Of this solution one or two fluid drachms can be used with Siegle's steam spray inhaler, a mode especially applicable in case of throat affection. Another very good spray solution is made by substituting *boracic acid for tannin*, or if a styptic be required, adding the tannin as well.

When the peroxide spray is brought into use it is good practice, in some cases, to make the spray the means of administration, in small doses, of medicinal agents which may act internally. Some mercurial preparations may be administered in this manner, and also soluble preparations of opium.

It may be added that peroxide solution goes well with alcoholic solutions containing many agents, soluble in alcohol, and afterward miscible with water. In combination with it, in this manner, most of the essential oils and various ethers can be administered.

Application in the Form of Gargle, Collyrium, Lotion, or Ointment.

Gargle.—The peroxide solution can be prescribed as an antiseptic and astringent gargle. A good form for this purpose is:

Tannin, pure, 10 grains; Glycerine, pure, 1 ounce; Rectified spirit, 4 fluid drachms; Distilled water, 4 fluid ounces; Solution of peroxide of hydrogen (10 vols.), sufficient for 8 fluid ounces. To make an eight-ounce gargle, to be used in the manner directed.

A rapid mode of treating the fauces in ulceration and in the diphtheritic condition consists in sponging the affected part first with solution of permanganate—Condy's fluid will do—and following that up by another sponge charged with the solution of peroxide. The escape of oxygen is very free, and the solution must be applied with care so as not to provoke cough.

Collyrium.—The peroxide is useful as a collyrium, especially in cases where there is purulent secretion. The following is a good combination:

Solution of peroxide of hydrogen (10 vols.), 4 drachms; tannin, pure, 5 grains; rosewater to 8 fluid ounces. To make an 8 ounce collyrium, to be used in the manner directed.

It will be observed that the quantity of the peroxide solution prescribed above is very small. This is recommended because the solution is apt to give smarting and pain at first if it be applied too freely; but the quantity can be increased so soon as the effect of it is determined.

Lotion.—An evaporating lotion can be made with the peroxide in the following form:

Rectified spirit, 4 fluid ounces; anhydrous ether, 1 fluid ounce; distilled water, 4 fluid ounces; solution of peroxide of hydrogen (10 vols.) to 12 fluid ounces. To make a lotion of twelve fluid ounces, to be used as directed.

Ointment.—A simple yet useful preparation of the peroxide is an ointment, for inunction over the surface of the skin after scarlet fever, and other affections where there is free shedding of dead cuticle. To make the ointment—

Rub up ozonic ether with spermaceti ointment, so as to form a thin paste, which may, if desired, be rendered thick by the addition of a little more spermaceti, or thin by addition of olive oil.

Conclusion.

In closing these pharmacological notes it is well to recall the important fact that the remedy we have had before us has about it the peculiarity that it is a purely natural remedy, that it is not toxic, and that, with the exception of the danger of producing by it gaseous accumulation in the blood under some circumstances of its use—a danger which admits of being avoided—it is free of all risk. In its remedial application, too, there is no complexity; it is always oxidation. For asphyxia it is oxidation; for spasm it is oxidation; for breaking up pus and exudations it is oxidation; for destroying infectious and fetid organic secretions or exeretions it is oxidation; for producing eliminative action it is oxidation.

At the close of the paper on peroxide of hydrogen read before the Medical Society of London, in 1880, I said:

"Sir, in placing this memoir on the annals of the society, I guard myself, once and for all, from any exaggerated suggestions as to the value of this new medicinal agent. The subject is so novel, even to me after twelve months' learning and knowledge of it, I have feared to use a sentence that has not been measured and recast over and over again. I am not offering this medicine as an elixir vitæ. I do not pretend to know all its properties. I do not bind myself, irrevocably, to that which, on the present occasion, has been offered; on the contrary, I remain open to all new observation and knowledge for correction and guidance. I believe we have here within our grasp a powerful medicine, the full value of which it may take years to develop, and the useful application of which may be developed in directions different from those now advanced. My purpose will be served if I but call forth investigation and elicit fact; let the course of the events bend as they may."

A generation has passed since these words were spoken. I repeat them with more knowledge, more experience, and more confidence, but still expressing the same earnest hopes, the same candor, and the same respectful confidence in the voice of the future.

TOBACCO, INSANITY AND NERVOUSNESS.

By Dr. L. BREMER, of St. Louis, Mo.

THERE is no narcotic, either in modern or ancient times, which has been and still is so universally in use as tobacco, and there is none about whose action on the human body there is so much difference of opinion among the laity and the profession.

By some it is looked upon as an unmitigated evil, it is claimed by others that its use is not without advantage. Hence it has been condemned and commended in turn.

Without entering into preliminaries and details, I will state at the outset that I side with those who, looking at the injurious effects collectively, consider it as harmful as alcohol, from the simple fact that its use is more general, its effects more gradual and less obvious, and that, from a moral point of view, it is in better standing.

The breath of tobacco is held permissible, and will be condoned by all classes; that of alcohol is looked upon as odious, and exposes its bearer in some quarters to social ostracism.

It is this connivance, on the part of public opinion, at this kind of luxus-consumption, as it is euphoniously styled by modern physiologists, that fosters its spread, especially among those who can least afford to offer any insult to their nervous systems. With advancing civilization it is considered necessary by many to use a sedative or a stimulant of some sort as a kind of a safety valve for the growing nervousness of our age.

Thus, by many smokers it is thought that after bodily or mental exertion an equilibrium of all the functions is re-established by the pipe, cigar, or plug. Its action, therefore, is somewhat like that of coca in its pleasant effects.

This is the case in the healthy smoker as long as he keeps within certain limits. But it is quite different with the vast and ever increasing army of neurasthenics and psychopaths of our days.

Our ancestors were evidently not so deleteriously affected either by alcohol or tobacco as modern man is, with the strain of the requirements of a more complicated life weighing upon him, and handicapped, as he frequently is, in his nervous and psychical make-up.

It is specially of the effect of tobacco on this latter class that I wish to speak, and, to start with, I venture the broad assertion that whereas the robust and healthy, especially if he lead an active outdoor life, may use tobacco in its various forms with apparent impunity, *i. e.*, without experiencing any demonstrable damage to body or mind, the neurasthenic and the psychopath have no business either to smoke or chew.

But it is just persons of this category (who are often not at all aware of their morbid condition) that become such absolute and powerless slaves to the habit. They fall victims to it early in life as rule. While the healthy human organism revolts against the drug as intensely as that of a dog or a cat, and has to gradually accustom itself to overcome the unpleasant sensations accompanying the first attempts at using it, the born neurasthenic often takes to it as the young duck does to water. Only in this manner can the peculiar phenomenon of infant smokers be explained, if one does not prefer to look upon such perversion of appetite as a species of precocious moral insanity inherited from parents who are generally not only excessive tobacco users, but evidently mentally defective.

Now, I do not believe that, with approaching maturer years, I am one of those who eye through pessimistic spectacles the rising generation, but I simply repeat the everyday observation, which I have never seen doubted or contradicted, that there is an alarming increase of juvenile smokers; and, basing my assertion on the experience gathered in my private practice and at the St. Vincent's Institution of this city, I will broadly state that the boy who smokes at seven will drink whisky at fourteen, take to morphine at twenty or twenty-five, and wind up with cocaine and the rest of the narcotics at thirty and later on.

It may look like overstating and exaggerating things when I say that tobacco, when habitually used by the young, leads to a species of imbecility; that the juvenile smoker will lie, cheat, and steal, which he would not had he let tobacco alone. This kind of insanity I have observed in quite a number of cases at the St. Vincent's. The patients presented all the characteristics of young incorrigibles. They had exhausted the indul-

gence of their parents, who saw no other way to protect them from their insane pranks than to commit them to the institution.

I do not know whether a lasting improvement was effected in any of them. There was not one among them that was able to comprehend that tobacco was injuring him; they were constantly on the lookout for obtaining it, by begging, stealing, or bribing, and regarded the deprivation of the drug as a punishment. The sense of propriety, the faculty of distinguishing between right and wrong, was lost. The father of one of them, who looked upon his son only as an aggravated case of bad boy, told me that he himself had been smoking ever since his tenth year, and it never had affected him. In reality, being only forty-five years old, he was a wreck, physically and mentally, though he came of healthy stock. He could not or would not comprehend that tobacco was gradually undermining his own mind and body, although his wife and his friends knew and saw it.

But it is not only in the young that the use of tobacco is followed with such disastrous effects. Smoking or chewing, when commenced in the period of manhood, and even at the time it generally does least harm, after middle age, will tell on the mind if excessively indulged in. Is it to be wondered at that a drug which, until tolerance is established, has such potent and palpable effects as to produce loss of co-ordination and unspeakable malaise, and after the organism has become used to it, is capable of setting up the well known heart disturbances, amblyopia and even amaurosis, which, in short, possesses the characteristic qualities of a powerful nerve poison—is it a wonder if such drug, when, in spite of the warnings on the part of various organs, excessively and persistently used, finally produces one or the other form of insanity? A drug that can, as has been demonstrated, cause organic changes of the optic nerve, which, I hardly need mention it, is, in reality, not a nerve, but a protrusion or elongation of the brain itself, must certainly be capable of injuriously influencing other and functionally higher parts of the organ of the mind.

Dr. Kjelberg read before the section of neurology and psychiatry of the last International Congress a paper in which he described a nicotine-psychosis, well marked by definite symptoms and stages. I have never seen the clinical picture as drawn by this observer, but it always seemed to me that whenever tobacco entered at all as a factor in a case of insanity, it was the immediate cause, vivifying, uniting, and condensing, as it were, the dormant morbid elements which predisposed the individual to mental disturbance. Thus I have seen melancholia, more often mania, and very frequently general paresis, hastened and precipitated by excessive use of tobacco. I know, however, of instances where the last named disease, or "softening of the brain," as it is called by the lay public, could not be referred to any other cause but tobacco.

That the majority of the insane smoke or chew is too well known to deserve special mention. Some alienists have been of the opinion that this habit ought not to be discouraged, that it has a calming and pacifying effect, especially on the chronic insane. I believe this to be the case in some of the secondary dements, but ordinarily, though calming at first, it has an exciting effect later on. True, if the temporary contentment resulting from the gratification of the craving of the patient is looked upon as the action of tobacco, I agree that its effects are calming. But this quieting down, in my opinion, takes place on the same principle that a child gets quiet and stops crying when its wish, even though most unreasonable, is gratified. The rule is, that smoking causes or prolongs excitement in the insane. Many become absolutely unmanageable as soon as they touch tobacco. They get quarrelsome, tease and molest their fellow patients, and render themselves obnoxious generally.

That tobacco really does cause insanity is evidenced by the magic effect seen in some cases after the discontinuance of the drug, when the patient's condition is still such that he is not wholly inaccessible to reason, and has will power enough to abandon the habit. Thus I have seen that beginning melancholia with suicidal impulses, hallucinations of various kinds, forced actions, besides the precursory symptoms of insanity, such as insomnia, crying spells, præcordial anxiety, fears of impending evil, "that *something* is going to happen," impotency, vertigo, beginning impairment of memory and judging power, and even the lowering of the moral tone, all of which, and a host of other symptoms, were attributable to chronic tobacco intoxication, disappeared after freedom from the habit was established. One of my patients experienced among other morbid symptoms an almost uncontrollable desire to throw himself out of the window whenever he had to go to the upper stories of the house in which he was employed; this impulse was so overpowering that he did not dare to approach the windows, and was in mortal fear of high places. He was a smoker and a neurasthenic. The discontinuance of the drug terminated his morbid impulses and fear.

But whenever a case has gotten so far that commitment to an institution has become necessary, the prospects are not so good, because such persons, as a rule, cannot be convinced that tobacco is, or has been, the cause of their mental trouble. Their argument is that almost everybody smokes, that all their friends and acquaintances chew or smoke, without showing any symptoms of insanity. This is an argument which it is hard to invalidate, because the smoker does not appreciate the law of difference and variability of the resisting power on the part of the organism, although this law is a matter of everyday observation. While some persons seem to be proof against almost any injurious agencies, others will yield on the slightest occasion to much less powerful influences, mechanical, toxic, or morbific in the stricter sense. Again, the susceptibility to injury varies in the same individual.

This discrepancy, in effect, is certainly not a matter of difference in quality. As remarked before, all this is a question of resisting power produced and governed by racial, social, climatic, industrial, and a number of other more or less occult influences. Now, all observers agree that in our country many conditions conspire to make us a nervous people, to produce what has even been styled "American nervousness." This "nervousness" in other words means a weakness, an instability, a vulnerability of the nervous system. Add to this the unquestionably strong quality of the tobacco which the taste of the American public exacts from the manufacturer, and it becomes plain that there exist two cogent reasons why we should be on our guard against the indiscriminate use of the article. The alcoholic insane, when leaving the institution to enter active life again, generally knows and admits that alcohol has been the cause of his mental breakdown; the nicotine victim does not admit anything.

French medical observers are of the opinion that one of the factors causing the depopulation of France is the excessive use of tobacco by its inhabitants; for the offspring of inveterate tobacco consumers is notoriously puny and stunted in stature, and lacks the normal power of resistance, especially on the part of the nervous system; again, in our country, it is a significant fact that an astonishing percentage of the candidates for admission to West Point and other military schools are rejected on account of tobacco hearts; from all countries and from all classes of society come reports in increasing numbers of the baneful effects of the tobacco habit.

But the consumption goes on, and will do so until an example is set by those who, above all others, can estimate the disastrous effect of the habit.

If teachers, preachers, and physicians would pronounce the anathema on tobacco and abstain from it themselves, others would follow. But here is the difficulty. It is only exceptionally that a smoking pedagogue, clergyman, or physician can be convinced that he would be a better man physically, intellectually, and morally, if he would give up tobacco, and that he has no idea what capabilities of well-being he possesses, if he could only muster up moral courage enough to abandon the use of a drug which in nine cases out of ten produces, to say the least, a vague sensation of uneasiness and restlessness, which only too often calls for a remedy that will do away with these effects, and that is alcohol. Some are aware that tobacco alone is responsible for a continual malaise or misery, especially when their attention is called to it by others, but like the cocainist, who asserts that the effects of cocaine are horrible, and still goes on using the poison, so the tobacco slave is bound, as by fate, to again indulge in a drug which he knows causes him to suffer. It must be a strangely potent fascination, indeed, which tobacco exercises over the bulk of its victims, when we consider that some are aware that tobacco is at the bottom of all their ailments. The question naturally arises in this connection: Why do people smoke when they know that as soon as they touch tobacco they experience immediately its toxic effects? Many a smoker rises in the morning bright and energetic; the nicotine absorbed during the previous day has been eliminated from his tissues, thanks to his well-meaning and powerful excretory organs. He smokes his first cigar after breakfast, becomes at once restless, dissatisfied, peevish, and disagreeable; the cigar stamps its signature on his mind for the rest of the day. This is the experience of many a neurotic smoker, and yet he will resume the practice day after day, making his own life a burden, and rendering everybody around him miserable. It is easily intelligible why some persons take alcohol; this is primarily a stimulant and secondarily a paralyzant, but tobacco paralyzes at once; it lowers all the faculties except those of fancy, and tobacco phantoms are not of much value. The downfall and general backwardness in civilization so characteristic in the Oriental people is largely due to their dreamy disposition engendered by abuse of tobacco.

Some, however, labor under the delusion that it increases their working power, that the flow of thought becomes easier, and that without tobacco they are unable to do any mental work. Instances are cited by them of great men, inveterate and excessive tobacco consumers, who left their mark in the history of civilization as savants, artists, etc. They do not consider the possibility that these men accomplished what they did in spite, but not in consequence of, or aided by, their habit.

Students of chronic nicotine intoxication are convinced that the great men among the tobacco slaves would have been still greater had they never used the drug. Thus Kant, the most eminent of German philosophers, is said to have written such an obscure and unintelligible style, because he smoked and snuffed to excess. I myself know of a medical man who wrote a great book which labors under the same defect as Kant's works, because of his slavery to tobacco.

But these things are trifles when compared with the destructive and degenerative influences the drug exerts on the broad masses.

There is only one way to lessen the evil—it is the dissemination of knowledge of the baleful effects of tobacco among the rising generation, initiated and sustained by the three professions mentioned above. Of course, they ought to practice first what they are going to preach.

I know of physicians who not only smoke to excess themselves, or, still worse, indulge to a morbid extent in the unmannerly habit of chewing, but permit and even encourage their own children to smoke. One of them was in the habit of awarding his thirteen-year-old son by extra good, *i. e.*, extra strong, cigars for high numbers in school. It is hardly necessary to add what became of this boy. He is now a periodical inmate at various sanitariums for a combination of bad habits.

In view of such discouraging facts I hardly expect much good from this contribution and testimonial to the pernicious effects of tobacco, because the truth has not dawned upon the multitude yet. As in the body politic evils will run their course until there is a general uprising of common sense which disposes of them, so with the irrational and excessive use of tobacco, which will probably go on increasingly, until a limit of endurance is reached, and the disastrous results of the abuse become patent enough to impress even the dullest mind.

But under existing conditions the habit will not want for new generations of victims as long as the cigar is looked upon as a symbol of manliness by the young, and the pipe as that of peace and comfort by the adult, and as long as tobacco is praised in word and picture. —*Quar. Jour. of Inebriety.*

IN a recent number of the *Lancet*, London, an account is given of the successful cure of pneumonia by the administration of oxygen gas. The relief was immediate and the cure rapid.

SYPHILIS AND CIGARS.

DR. W. S. GOTTHEIL, writing in the *New York Medical Journal*, gives some very disagreeable information as to the manner of finishing cigars, and of the dangers which may consequently beset the smoker. The suggestion that contagious disorders, and especially syphilis, may be transmitted by cigars is not new, but the piece of evidence brought forward by Dr. Gottheil is of a particularly circumstantial kind. During last January a pale, anæmic girl, aged 19, consulted him on account of a disorder which he had no hesitation in recognizing as a typical hard chancre upon the upper lip. A general macular syphiloderm was present on the face and body: there was a diffuse specific pharyngitis, marked adenopathy, and moist papules on the labia and in the vagina. On inquiry it was found that she was a cigar finisher, her work being to take the cigars from a machine, bite off the ends, and use her saliva for shaping the tips. She stated that a friend, a girl who finished cigars upon the machine next to hers, had a similar lump upon her lip three months before, and as they used the same cup to drink from at lunch, she thought she must have caught the disease from her friend. The friend, who was aged 18, was seen later, and stated that a pimple came on her lower lip on October 2, and enlarged to the size of a nut. She gave a history of eruption, loss of hair, sore throat, rheumatic pains, and rash, and when seen presented large mucous patches on the tongue. Neither girl would believe that her disease was contagious; both continued to work finishing off the ends of cigars with saliva, "because it would take too long to use knife and paste." It appears to be useless to attempt to induce the work people to resort to more cleanly methods, but it is thought that the abuse might be checked by imposing a penalty on the employers who permit such a method to be used. It is, however, almost impossible to compel work people in any trade to employ methods which involve a little extra trouble, even for their own protection. The story is likely to spoil the flavor of a good many cigars for some time to come, even if it be true that the tobacco leaf and the tobacco juice in the mouth "render the contagious element innocuous."—*British Medical Journal.*

PLANETARY NEBULÆ.

By Miss A. M. CLERKE, authoress of "A Popular History of Astronomy during the Nineteenth Century," and "The System of the Stars."

THE question "What is a nebula?" put by our editor to himself and his readers in the last number of *Knowledge*, must have brought home to many minds, with startling distinctness, the extreme difficulty of forming a rational conception as to the real physical status of cosmical clouds and cloudlets. They lie, indeed, so far beyond the range of our immediate experience, that observations of them are apt to become more perplexing the more they are rendered minute and detailed. Speculations regarding their nature have hitherto been sternly checked by the collection and verification of facts. They flourish only under the shelter of a certain amount of vague generality, while the test questions which every theory worthy of the name must sooner or later put to experience, have so far uniformly been answered in the negative. Added knowledge has not, accordingly, in this direction, brought clearer understanding. In the registration, for instance, especially by photographic means, of lines in the nebular spectrum, and in the accurate determination of their places, much has of late been done; but their interpretation remains as backward as ever. Nebular chemistry has scarcely yet entered upon the path of progress; what it has done hitherto has been mostly to put a veto upon mistaken identifications, leaving affirmative propositions to the future. It is acquainted with but one terrestrial element; almost the only positive assertion warranted by the evidence at its command is that hydrogen is extensively present in the "fire mist" of the skies, and present in a state of high molecular agitation. This indeed is a most important piece of information; the possibility of obtaining it proves nebular to be separated by no impassable gulf from terrestrial conditions, and gives good hope, accordingly, of eventual advance along this line of investigation.

A peculiar interest, then, attaches to the detection and demonstration of structural resemblances between nebulæ and other heavenly bodies. Mr. Ranyard pointed out some few years ago the faithful imitation of solar prominence-forms by some of the gigantic outgrowths of shining fluid from the trapezium of stars in Orion; and the resemblance is accentuated by the undoubted presence in the nebula of the solar element helium. Cometary analogies, on the other hand, are backed by no well ascertained chemical coincidences; yet they are prevalent and remarkable. The wings and wisps, the tails, rays, and trains, the complicated varieties of tenuous veils and envelopes that develop together or in succession during the rapid sweep of a great comet round the sun, are reproduced over and over again, with endless modifications, in the "lucid matter" of remote space. But they are stereotyped in being reproduced. Forms that might well be concluded to be purely transitional, and that are in the highest degree suggestive of evanescence, are nevertheless maintained, decade after decade, without appreciable modification. Processes of change are no doubt meanwhile progressing ceaselessly, but on so vast a scale in space, and at so leisurely a rate in time, as completely to baffle human observations during the short span available for them. Hints as to their character may, however, in the course of years, be gathered by studying the distribution of matter brought about by their action. The curious discovery, moreover, has of late been made that data on this subject may differ widely, and lead to widely different conclusions, according as visual or photographic means are employed to procure them. This incongruity between effects to the eye and impressions on the sensitive plate first became apparent in M. Trepied's photograph of the annular nebula in Lyra (*Knowledge*, vol. xiii., p. 253); it has now been found to characterize two well known planetaries, and may be inferred to belong, more or less, to all members of the same class.

The distinction between annular and planetary nebulæ has been to a great extent abolished by the

use of improved optical appliances. Each kind seems to be made up of three essential parts: a faintly shining disk—or globe projected into a disk—a ring-like condensation near its outer margin, and a central nucleus, presenting the appearance of a star. The last feature is often *seen* only with extreme difficulty, but there is reason to believe that it always exists. Mr. Burnham, who has measured a large number of these objects with the Lick 36-inch, for the purpose of providing a standard of comparison for the determination of their possible future movements, goes so far as to suggest that the presence of a central star should be regarded as the criterion of classification for planetary nebulæ.* He adds: "Various powers have been used in studying these central stars, and particularly the brighter ones. In no instance has any one of these stars presented under any power any peculiar appearance. So far as it can be determined in this way, they all appear to be true stars, differing in no sense from the comparison stars. Many of the nights on which these measures were made were of the best quality, and any nebulous or other unusual appearance should have been apparent if it really exists."

Nevertheless, photography has a very different story to tell, as we shall see presently.

A small bluish disk observed by the elder Herschel near the star ν Aquarii was estimated by his son as an equal in light to a 6·7 magnitude star, and took its place as No. 4,628 in his general catalogue. It is No. 7,009 of Dreyer's new general catalogue. With the Parsonstown reflector, in 1850, the surface of the nebula appeared tolerably uniform; it was interrupted by no certifiable perforation, and emblazoned by no central star. It gave the effect, however, in 1873, not of strict ellipticity, but of being made up of two overlapping circular segments.† It was seen, besides, to possess a pair of singular appendages like the "ansæ" of the ringed planet in our own system; and Mr. Lassell's first impression of the object at Malta was that of "a sky blue likeness of Saturn." An interior ring, too, measuring 26″ by 16½″, and projected upon a hazy background, was plainly visible; while a small star marked the middle point of the entire formation. Yet the great Vienna refractor failed, in 1883, to display the star to Vogel, although a power of 1,500 brought out complexities of internal nebulous arrangement strongly suggestive of an essentially spiral structure. The results of Professor Holden's scrutiny of the "Saturn planetary" in August, 1888,‡ with the Lick 30-inch, deserve careful consideration. He found it to consist mainly of a star, or nebulous nucleus, surrounded by an elliptical ring lying upon an oval shield much less vividly luminous, while two exterior nebulous patches, situated nearly in the prolongation of the major axis of the ellipse, seemed to be connected with it by faint gleams of phosphorescent illumination. These represented the "ansæ" of earlier observations, and indeed their detachment from the main body had been suspected at Parsonstown in 1852, and pretty well made out in 1862. Possibly, they are embryo-satellites of the nebulous system they are still partially attached to; nor can their position relative to its longest diameter be easily regarded as accidental. We are irresistibly led, on the contrary, to trace an analogy between them and the nebulous effusions from the extremities of the major axis of the annular nebula in Lyra, and to infer in both cases the genuinely oval shape of the objects presented to our view. For why should a mere perspective effect be emphasized in any way by physical configuration?

The nebula in Aquarius was perceived by Professor Holden as of a pale blue, but its stellar nucleus as white; the difference of color being in fact so decided as to require a change of focal adjustment in passing from one to the other. The interior arrangements of the nebula were evidently extremely intricate. The central oval, instead of being bounded by a smooth curve, "looked like an elastic link which had been warped." A sudden failure of light in the glimmering ring near the southern extremity of its minor axis enhanced the effect of distortion; but a helical form, though suggested, could not clearly be made out.

A strikingly similar object is situated in the constellation Andromeda (N. G. C. 7,662). Imperfectly seen at first as a uniform, greenish blue disk, an interior vacuity detected at Parsonstown betrayed its true nature to be rather annular than simply planetary. Nor is the ring it includes by any means symmetrically shaped. Lassell considered it to be bi-annular; Professor Vogel was impressed with the warped and twisted aspect of what may conceivably prove to be a multiple combination of rings thrown off in various planes. Closely wound spiral branches, and a central star, were perceived with the Rosse reflector; but the object appeared starless to Dr. Struve in 1847, as well as to Searle, using the Harvard 15-inch refractor, in 1866. Lassell gave 32″ by 28″ as the dimensions of the outer ellipse; and saw the "central star" in the guise of a minute planetary disk, tinged with blue. To Vogel, however, it was entirely invisible, in spite of his best efforts for its discovery. Yet he noticed the sparkling appearance which had misled Father Secchi into the belief that he held in the field of his equatorial a "magnificent ring of stars."§ For the "horseshoe of star dust" in Andromeda, like its *alter ego* in Aquarius, gives the usual gaseous spectrum of planetaries, which is now known to include, as a fourth visible line, the blue ray of wave length 469, distinguishing stars of the Wolf-Rayet type.

The photographic study of these two nebulæ, lately set on foot by Dr. Scheiner at Potsdam, may be expected to add much and rapidly to our knowledge of their nature and conformation. The images obtained of them, although only half a millimeter in diameter, show a considerable amount of detail. They confirm the annular shape attributed to them on the warrant of telescopic observations, and bring out, with singular strength, the central nuclei which the best telescopes have not always availed to display. In the photographs these are, nevertheless, the brightest parts of each formation. Yet they are mere irregular condensations, with no pretensions to a stellar nature. The superiority of their actinic power repeats the phenomenon first brought into notice by photographs of the Lyra nebula, and seems to point to a general law. Dr. Scheiner thinks it can only be accounted for by supposing a predominant quantity of some peculiar gas emitting, in the main, highly refrangible light, to be collected in the central regions of planetary nebulæ;* yet the resulting nuclei, when they can be seen at all, shine with a white light, bear a star-like aspect, and probably give continuous spectra. The problem of their real constitution is thus far from easy to solve. But, whatever the secret of their photographic effectiveness, it is already tolerably evident that they play a part of fundamental importance in determining the structure of planetary nebulæ. They are perhaps the primary seats of the forces by which these interesting objects are moulded into characteristic shapes; and the circumstance may be regarded as a particularly fortunate one that the camera is so well adapted to display and emphasize their complex relationships with the nebulous masses organized, as it were, under their immediate control.—*Knowledge.*

* *Astr. Nach.*, No. 3086.

* *Monthly Not'ces*, vol. lii., p. 31.
† *Trans. R. Dublin Society*, vol. ii., p. 159.
‡ *Monthly Notices*, vol. xlviii., p. 391.
§ *Astr. Nach.*, No. 1018.

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